DOCTORAL THESIS

Factors That Influence Performance in a Problem-based Learning Tutorial

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FACTORS THAT INFLUENCE PERFORMANCE IN A PROBLEM-BASED LEARNING TUTORIAL

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ABSTRACT

Introduction: Problem-based learning (PBL) is an educational approach that reflects a resourceful way of thinking about teaching and learning. PBL is a student group-focused pedagogy that uses an inquiry-based tutorial approach to learning. PBL is characterised by small group that uses tutorials rather than lectures as opposed to a didactic, lecture-based curriculum and it is commonly used in medicine and the health sciences in combination with traditional learning methodologies, as it helps students to develop the higher order thinking skills required to be successful in the medical profession.

Aims: This study has two aims. First, it examines the influence of four demographic characteristics (gender, age, educational level, home language) of the students in the MBBS medical program at Bond University, Queensland, on their perceptions of PBL, verbal interaction in PBL and academic achievement. Secondly, the results of the Bond University study was utilised to assess the feasibility of using a hybrid PBL approach that combine PBL and didactic teaching to a multicultural Middle Eastern Dental Hygiene program in Kuwait. In order to meet these aims, two measurement instruments and one data collection method, were used. The study was divided into two parts: Part A (survey) and Part B (utterance analysis).

Methods: In Part A, a questionnaire was developed to canvas Bond University medical students' perceptions of PBL. The questionnaire canvassed Year 1-3 students cross-sectionally and longitudinally. In Part B, a validated instrument was used to record the instances of students' learning-oriented utterances. Students' end of year (phase) assessment results were collected and correlated with their learning-oriented utterances.

Results and Discussion: This study found that PBL is accepted as a learning experience regardless of students' demographic characteristics or backgrounds. Although the demographic characteristics of students in the present study did not impact significantly on their acceptance of PBL as a learning experience, one demographic factor (age) was found to impact on students' perceptions of and

performances during PBL tutorials. To this end, younger students (16-20 years old group) perceived PBL positively more than did older students. Year of study was identified as another factor that could influence students' views and learning-oriented utterances during PBL tutorials. First year students scored higher in two of the inventory subscales: group process and tutor practice. Moreover, Year 1 students engaged critically but constructively by asking higher order questions more than did their second year counterparts. The correlation between student and tutor learning-oriented utterances was both weak in magnitude (less than 1) and direction (negative sign). No evidence of association was found between the students' verbal interaction and their academic achievement. The proposition that students with different demographic factors perceived PBL differently was proven incorrect in the present study.

Conclusion: The inclination toward a more tutor-directive style might be due to the lower levels of prior knowledge and lower confidence of younger students. Tutors with content knowledge can, however, have a positive and negative impact on students' contribution. The findings of the current study of a diverse group of medical students suggest that hybrid PBL approach might be appropriate as an educational approach for the Dental Hygiene program (College of Health Sciences, Kuwait).

DECLARATION

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of *Doctor of Philosophy*.

This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this University or any other institution, except where due acknowledgment is made.

Candidate signature: Noura Alajmi

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

RATIONALE

1.1. Introduction

Problem-based learning (PBL) is a student-centred approach in which students learn curriculum content through problem-solving within a stimulated professional context, usually contained in a written case scenario. Furthermore, the cases were used to drive learning about basic biomedical sciences such as anatomy, physiology, pathology, microbiology and pharmacology as well as clinical sciences and biopsychosocial issues raised in the case. Despite the use of this educational approach in many countries and academic disciplines, it has only been more recently that PBL has been adopted in medical schools in the Middle East. This thesis examines the factors that may contribute to the effectiveness of PBL by studying a group of medical students at Bond University, Queensland, with the view to factors that should be considered in assessing the feasibility of introducing a hybrid model of PBL educational strategy in an undergraduate dental hygiene program in Kuwait.

Several factors are necessarily explored to assure the successful implementation of a preliminary learning experiment. To this end, such factors would include are student demographics as they could influence learning styles and attitude toward the learning experiment. Additionally, factors such as the tutor facilitation style and PBL cases could contribute in the efficiency of any educational approach methodology. In this study, the student factor was largely explored, while the effect of the tutor was examined to a certain extent to substantiate the dependent variables of those two factors.

Due to the limited time frame and the non-availability of a similar educational situation at the targeted site, i.e. College of Health Sciences, Dental Hygiene program, Kuwait, and the availability of the resources in Bond medical program, this study was conducted at Bond University. Bond medical students were canvassed about perceptions of, participation in PBL tutorials and their end of phase academic achievement as an indication of the successful implementation of PBL. The findings could contribute to the decision of assessing the utility and applicability of such a learning as PBL experiment to a different region of the world, i.e. Kuwait Dental Hygiene program.

In this study, the factors that may have an impact on the PBL process were investigated using two instruments. These included a Likert scale questionnaire to survey students' perceptions (Part A, Chapter 3) and an observational valid instrument to score student utterances in PBL (Part B, Chapter 4). The data were analysed to determine whether correlations exist between an individual student's tutorial utterances and his/her demographic characteristics (Chapter 4). In addition to the instruments described above, students' final grades were examined in order to ascertain whether there was a correlation with the results of the valid measurement instrument and students' academic achievement (Chapter 4). Chapter 5 is a synthesis and summary of the research outcomes as well as comments, the limitations of the present study and recommendations for future work will be discussed.

1.2. Rationale for the study

PBL is a student-focused, inquiry-based tutorial approach to learning in which students collaborate in small groups to discuss and work through a simulated problem (Margetson, 1998; Savin-Baden, 2000; Cleverley, 2003; Schmidt, 1993). As PBL is a learner-centred approach and revolves around group work, many factors can influence its effectiveness, particularly in multicultural settings, where in addition to gender and age, educational background and home language may impact on effective group function.

The aims of this study were two-fold. The first aim was to evaluate the effect of four demographic variables (gender, age, educational background, home language) on students' perceptions of PBL. The second aim was to ascertain whether students' demographics influence their verbal interaction in PBL group sessions and whether the level of contribution during the small group tutorials correlates with their final academic grades. The final aim was to assess the applicability of the Bond PBL experience in terms of student demographics to a Dental Hygiene program in Kuwait.

Language competency in instruction and interaction with peers is an important factor in learning. PBL was primarily developed in the 1960s by English-speaking

Canadian scientists and was therefore conducted in English. Since then, PBL has been widely adopted in other countries, most commonly where English is the lingua franca. In the Middle East, PBL was, however, not adopted until the 1980s (Mpofu *et al*., 1998; Haghparast *et al*., 2007; Suleman *et al*., 2010; Kahraman *et al*., 2011).

PBL is based on the presentation of an ill-structured problem that is analysed by a group of 7-10 students. The PBL process is designed to develop students' higher order thinking, facilitated by a tutor. Although the small groups used in PBL allow students to discuss problems freely, some students might not contribute to the PBL discussion for a number of reasons, including personal (shy, withdrawn), cultural (cultural background prohibits putting themselves forward, e.g. Saito *et al*., 2007), preparatory (have not completed the necessary research or read the related materials) or simply because of a lack of interest, e.g. Krishnan *et al*., 2011.

Motivated by the need to produce skilful dental hygienists who are also problem-solvers able to integrate knowledge in the context of patient care, it was proposed in 2007 that a more active and learner-centred approach be introduced in the Kuwait Dental Hygiene Program, College of Health Sciences at the Public Authority for Applied Education and Training (PAAET).

An understanding of the factors that contribute to effective group function is important in terms of informing the possible implementation of PBL as an educational approach. The current Dental Hygiene course in Kuwait is traditional in that it is teacher-centred and didactic. With PBL now widely accepted not only in medicine but also in most allied health professions, a thorough evaluation in a multicultural context similar to that of the Kuwait Dental Hygiene students was necessary. Due to its diverse student body, which includes students from different cultural backgrounds, Bond University was chosen as the study context in order to examine the influence of language as reflecting culture on the PBL process.

Although several studies have compared PBL with conventional teaching methods (Vernon & Blake, 1993; Strobel & van Barneveld, 2009), few studies have examined PBL effectiveness across different higher education institutes (Strobel & van Barnevel, 2009). The focus of this study is not a comparison of two different

teaching methodologies and learning approaches (i.e. PBL and conventional lecture-based learning). Rather, the emphasis is on exploring the factors that influence PBL experiences in order to determine whether the implementation of PBL in a demographically diverse academic environment with different supporting factors would yield the desired outcomes.

A number of earlier studies have investigated the importance of adopting PBL in medical and health sciences schools (Spencer & Jordan, 1999; Colliver, 2000; Koh *et al*., 2008). The present research, however, differs from those studies in that the researcher sought to analyse the PBL experience itself by studying the views and behaviours of students in PBL and by investigating the influence of several demographic factors on their experiences. The association between those factors is also explored. Detecting an association between students' learning oriented utterances during PBL tutorials and their academic performance is one of the primary objectives of this study.

1.2.1. Educational theories underpinning PBL

The investigation and educational research undertaken by philosophers, psychologists and educators over the years has led to new and revolutionary approaches, methods and strategies in education. Students are now expected to receive an education that equips them for the demands of a challenging, complex and chaotic world in which they provide creative, realistic and well researched alternatives to address the problems (Rose & Best, 2005).

Students need to demonstrate their understanding through numerous real-life, authentic experiences, using a variety of sources of information that have been validated and justified, by examining a range of perspectives, utilising diverse contexts, demonstrating expertise in collaborating and consulting both locally and globally to determine their "truth" and being able to justify their decisions (Tearle *et al*., 1999). These are the attributes required of the student participating in the PBL learning process.

PBL was further developed by educational psychologists such as Jerome Bruner

(Bruner, 1968; 1971), who researched the process of inquiry and investigative learning as opposed to the didactic and directional teaching that predominated in the 1950s. Many theories of learning have been developed that may serve as useful vehicles for understanding the construct of PBL as an advocate of adult learning principles (Ozuah, 2005). In contrast, Empiricism, advocated by the British philosophers, Bacon, Locke and Hume, considered people to be empty slates on which nature defines its laws (Schmidt, 1993) and in which the learner has little power. Arguing against this, the theory of Rationalism presupposes that our knowledge is what we know of the world and is primarily the product of our experiences and background thinking, which leads to understanding (Popper, 1959). The cognitive structure of the rational learning model is one in which knowledge is stored in long-term memory and organised in a certain way that allows it to be retrieved when needed (Schmidt, 1993).

PBL conceptualizes several elements of Cognitive Theory (Ozuah, 2005; Schmidt, Loyens, van Gog & Paas, 2006). Cognitive Theory explores the acquisition of knowledge and problem-solving skills that can be applied to complex contexts. The acquisition of knowledge and problem-solving that is addressed in Cognitive Theory is adopted in PBL when students use their own thinking skills to critically analyse the problems provided in the medical scenarios and share their thoughts and ideas with other group members in order to reach the most viable solution for the problem or case in hand. It requires students to intellectually engage in thinking about thinking (i.e. metacognition). Another theory, the Behaviourist Theory (Bandura, 1969; Skinner, 1974), advocates that an individual's response to different environmental stimuli shapes behaviour and so changes can occur in the observable behaviour of students as a result of input into the learning process and environment. In the PBL tutorial, this is observed when one student reads the case or problem and the triggers provided and the other students engage in a stream of focused discussions in order to think collaboratively about the problem and to make informed and appropriate decisions that provide solutions. Simple rewards such as praise and acknowledging peers' contributions can enhance the engagement within the PBL group.

The exchange of thoughts, exploring and testing out of ideas and developing of knowledge among students occurs in order to expand understanding to reach the most viable and defensible solution that has been validated by studies (Barrows & Tamblyn, 1980; Schmidt, 1983; Barrows, 1986, 1994, 1996; Gallagher, 1997; Duch *et al*., 2001; Kilroy, 2004; Dolmans, *et al*., 2005). These thinking activities construct new understanding and demonstrate the Constructivist Learning Theory (Ozuah, 2005; Fosnot, 2013), whereby the acquisition of shared understanding and knowledge results from collaborative, cooperative social learning in the situation of a small homogenous group.

The Developmental Theory, which proposes that individuals behave in each stage of their life according to certain standards expected, as proposed, is based on norms and appropriate behaviour, skills or knowledge for specific levels or stages of human development (Ozuah, 2005, Evans, Forney, Guido, Patton, & Renn, 2009). In the PBL tutorial, this is important because students at different stages of maturity display certain behaviours and apply their thinking skills according to their level of cognitive development and behavioural maturity (Piaget, 1977; Strange, 2004; Downing, 2012). PBL allows individuals to use their cognitive skills and abilities to obtain information and knowledge during the PBL process in a manner that is congruent with the Humanistic Learning Theory (Rogers, 1967; Maslow, 1970; 1972). This theory, i.e. Humanistic Learning Theory is based on the assumption that there is a natural tendency for people to learn and that adult learning will flourish if nourishing and encouraging environments are provided. It is based on a hierarchy of the needs of individuals and good tutors and students will recognise if these needs are not being met.

PBL has elements of all of these theories and educators need to be cognisant of how each affects the success of PBL. The most significant, it could be argued, is the Constructivist Theory (Harris & Alexander, 1998; Hendry *et al*., 1999; Windschitl, 2002; Birenbaum, 2003) because it depends mainly on the construction and acquisition of shared understanding and knowledge, which is developed while the students use their cognitive and communication skills to achieve collaborative learning during PBL tutorials. Students also adopt cognitive skills in the

Constructivist Learning Method when they are thinking critically and trying to analyse problems and retrieving their prior knowledge in preparation for the exchange of information with their peers.

1.2.2. Andragogy

In 1833, a German grammar school teacher named Alexander Kapp coined the term "andragogy" (Van Enckevort, 1971). Kapp used the word to describe the educational paradigm employed by the Greek philosopher, Plato. The concept of andragogy, which Knowles defined as "the art and science of helping adults learn", was contrasted with pedagogy, "the art and science of helping children learn" (Knowles, 1980). The term was not used extensively until 1926, when Eduard C. Lindeman wrote about it (Gessner, 1956; Ozuah, 2005). Andragogy has become a fundamental concept for those trying to define the field of adult education as separate from other areas of education (Marriam, 2001). Others have continued to explore his ideas (Bruner, 1959; Ausubel, 1968; Schmidt, 1993).

From 1959, Malcolm Knowles expanded on the work of Lindeman (Ozuah, 2005) by proposing "a new label and a new technology" – andragogy - of adult learning to distinguish it from pre-adult schooling (Merriam, 2001). Andragogy is based on five assumptions (Knowles, 1968; Taylor & Kroth, 2009) relating to the adult learner. These describe the adult learner as someone who:

1. Has an independent self-concept and who can direct his or her own learning;
2. Has accumulated a reservoir of life experiences that is a rich resource for learning;
3. Has learning needs closely related to changing social roles;
4. Is problem-centred and interested in immediate application of knowledge, and
5. Is motivated to learn by internal rather than external factors (Merriam, 2001).

These concepts of adult learning can be applied to students in a PBL curriculum, although some students enter university directly from school with limited life experiences and so may lack some behavioural maturity. But, adopting an adult learning style helps these students acquire behavioural maturity (Piaget, 1977;

Strange, 2004; Downing, 2012).

It was from these assumptions that a program-planning model for designing, implementing and evaluating educational experiences with adults was proposed by Knowles (Merriam, 2001). For example, with regard to the first assumption, that as adults mature they become more independent and self-directing, Knowles suggested that the classroom climate should be one of "adultness", both physically and psychologically. In an "adult" classroom, adults "feel accepted, respected, and supported". Furthermore, in that context, there exists "a spirit of mutuality between teachers and students as joint inquirers" (Knowles, 1980: p.47). Because adults manage other aspects of their lives, it can be argued that they are capable of directing, or at least assisting in planning, their own learning, and indeed should seek to do so. This should be especially evident in PBL experiences for adult students.

Situated learning is learning that takes place in the same context in which it is applied (Lave & Wenger, 1991). Learning should not be viewed as simply the transmission of abstract and decontextualised knowledge from one individual to another, but as a social process whereby knowledge is co-constructed. Such learning is situated in a specific context and embedded within a particular social and physical environment. In the construct of PBL in a medical program, planning the cases and linking the problems to the clinical context is important.

Good theoretical planning is required to effectively implement a PBL curriculum (Falk- Nilsson *et al*., 2002). Such planning should take account of underpinning educational theories when designing and implementing PBL programs so that the program builds on the competency that students already have and enhances reciprocity between the student and the tutor. PBL should build on the degree to which the curiosities of the students are stimulated and the degree to which the tutor is a role model for learning (Bruner, 1968; 1971). The integration of components of the medical program, either horizontally or vertically, with the PBL curriculum can be a good motivator for students, as it will enhance their knowledge base in a relevant context.

1.2.3 Students' demographic characteristics and PBL

A neglected area in PBL research is the impact of students' various demographics (e.g. gender, culture) on acceptance of and participation in PBL. This may contribute to some of the discussion about the effectiveness of PBL (Taylor & Miflin, 2008). The literature has shown that student views of what is appropriate education differs with age and background and these differences can have a powerful effect on the way a PBL curriculum is implemented and on its success (Dolmans & Schmidt, 1994; Bernstein *et al*., 1995; Walton, 1997; Miflin *et al*., 1999; Dolmans *et al*., 2001; Cunningham *et al*., 2006). Several studies highlight the differences between the learning approaches of different age groups within the student body (Miflin *et al*, 2003; Miflin, 2004), and the effects of differences on the way the small group functions in PBL (Miflin, 2004). Moreover, PBL could be practiced differently over time as the composition of a cohort changes depending on the participants' demographics and learning styles (Miflin *et al*., 2003).

In the current research, students were the independent factor used to evaluate PBL. This was achieved by studying the impact of various demographics on students' acceptance of PBL and by correlating participation during tutorials with academic achievement. Other factors such as tutor's educational background, type and quality of cases and a tutor's interpersonal skills were not investigated in this research as they are not relevant to the hypothesis tested nor the research questions developed.

1.2.3.1. Questionnaire: Evaluating perceptions

Surveys or questionnaires offer objective instruments of collecting information about People's knowledge, believes, attitudes and behaviours (Oppenheim, 1992; Sapsford, 1999). The perceptions of the students as an essential factor of the learning process or point of views they reflect towards PBL (Mpofu *et al*., 1998; Virtanen *et al*., 1999; and Hendry *et al*., 2003) are considered an important tool in evaluating its effectiveness as a learning approach (Pintrich & Garcia, 1991). The questionnaire was used to canvas students' perceptions of and attitudes toward PBL (Darby & Bowen, 1993; Visschers-Pleijers *et al*., 2005).

1.2.3.2. Measuring learning-oriented utterances

PBL groups become learning communities in which students take on the role of novices, moving from a legitimate, but peripheral, position into full participation in the professional community of practitioners (Lycke, 2002). Videotaping the PBL tutorials and observing students' verbal interactions in those videotaped sessions provides insight into how students from differing backgrounds perform (Tipping *et al*., 1995; De Grave, *et al*., 1996; and Visschers-Pleijers *et al*., 2006).

Group interaction plays a crucial role in stimulating student learning (De Grave *et al*., 2001; and Steinert, 2004). In observing time spent on the different types of interaction during PBL group sessions, it was found that learning-oriented interactions predominate, accounting for almost 80% of total session time in contrast to non-focused chat (Visschers-Pleijers *et al*., 2006). The research undertaken for this thesis will examine such interactions through measuring students' learning-oriented utterances on videotapes of recorded PBL sessions.

To provide a comprehensive analysis of the effects of students' verbal participation on student learning, the verbal interaction aspect of PBL should be considered through the use of videotaping/recording instruments in conjunction with a questionnaire and self-assessment. Students' verbal interactions were recorded utilising a valid instrument and categorised to learning-oriented utterances. Those learning-oriented utterances were examined and analysed. Measuring student's learning oriented utterances in PBL when viewed from video-recordings can provide important insights into the PBL process. Videotaping students and evaluating their verbal interaction against criteria was an important component of this study.

1.2.3.3. Impact of students' verbal interaction in PBL tutorials on their end of year grades

In the current study, it was anticipated that PBL process would not have an effect on the student's end of year assessment results. The relationship between students' grades and their participation in PBL tutorials have been reported in literature (Login *et al*., 1997; Segers & Dochy, 2001; Miller, 2003; McParland *et al*., 2004; Beers,

2005; Beachey, 2007). In examining the effect of PBL on British students' test scores, two cohorts of students participated in a study in which one group attended PBL while the other experienced the traditional didactic curriculum. All students learned more effectively during the teaching sessions in the PBL curriculum and recorded superior test results than those in the traditional classes (McParland *et al*., 2004).

To determine whether there would be a difference in students' performance and level of satisfaction in pharmacology in a PBL format compared with a traditional lecture format, a study was conducted on two regularly scheduled pharmacology sections offered within a college of nursing at an American state university (Miller, 2003). The students were clinical specialists enrolled in a Masters degree program. Findings from that study indicate that PBL and the traditional lecture format are both equally effective course delivery methods in terms of the academic achievements of students and in test scores.

In a Dutch study, a questionnaire and the scores of two tests on cognitive achievement completed by 165 First year psychology students enrolled in PBL curriculum were used (Pintrich & Garcia, 1991). Results showed that students who are better time-planners and who had better self-monitoring skills were more efficient in allocating their individual study time, prepared more appropriately for the tutorial group meeting and achieved higher scores on cognitive tests. Students who demonstrated strategic skills, which included setting goals, planning effectively and monitoring goal progress, were more likely to achieve higher on knowledge tests than students who failed to engage in these activities (Pintrich & Garcia, 1991).

1.3. Problem-based learning (PBL)

Until PBL, the traditional learning approach in medicine had been an apprenticeship model in which an expert instructed students (Cooke *et al.*, 2006). This model, however, inhibited curiosity and did not allow for the development of skills. Medical students and then practitioners were required to adopt approaches such as problem-solving and the critical thinking necessary to identify what they needed to know and

then where to find and interpret this information to "solve" the problem (Williams & Lau, 2004). Additionally, medical students were required to know a large amount of information at a limited time and within crucial circumstances. In response to this needed strategy of critical thinking in medicine and the growing volume of medical information, the PBL approach was developed at McMaster University, Canada, in the 1960s (Norman & Schmidt 1992) and PBL was first utilised in medical schools (Cheng *et al*., 2003). This approach focuses on inquiry-based, student-centred group learning (Barrows, 1986). Moreover, this PBL approach enabled students to reach the most suitable and viable diagnosis to the medical cases in hand. It is not surprising then that PBL is now commonly used in many medical schools (Gwee, 2008).

The learner-centred approach of PBL is based on students being provided with a scenario and then investigating it using the scientific method. During PBL tutorials, students are exposed to problems that require them to learn how to use intellectually engaged higher order thinking. First, a problem or case based on a real-life scenario is presented (Fig 1.1). Then, the students identify and clarify any unfamiliar terms presented in the case scenario before defining the problem or problems to be discussed. Next, under the guidance of a tutor, students activate and explore their pre-existing knowledge using a systematic process of discussion and exchange in the context of the problem (Norman & Schmidt, 1992; Schmidt, 1993). After that, a brainstorming process is then used to discuss the problem(s), with students suggesting possible explanations on the basis of prior knowledge. Students draw on each other's knowledge, identify areas of incomplete knowledge and negotiate the strategies for learning. The group then provides explanations that may lead to tentative solutions. They organise their explanations and restructure their hypotheses and findings if necessary. To shape their self- learning and solve the problem in hand, students then use scientific resources such as the library, lectures and practical's. Students acquire new facts and synthesize information in order to interpret the clinical scenario provided to them. They then learn to synthesize those pieces of information and concepts to construct and develop new ideas and learning. Finally, students reconvene a few days later to apply what they have learnt in order to "solve" the problem (Barrows, 1986). They evaluate their solutions or answers

based on their prior knowledge and new information and align their learning to the expected faculty-developed learning objectives and outcomes.

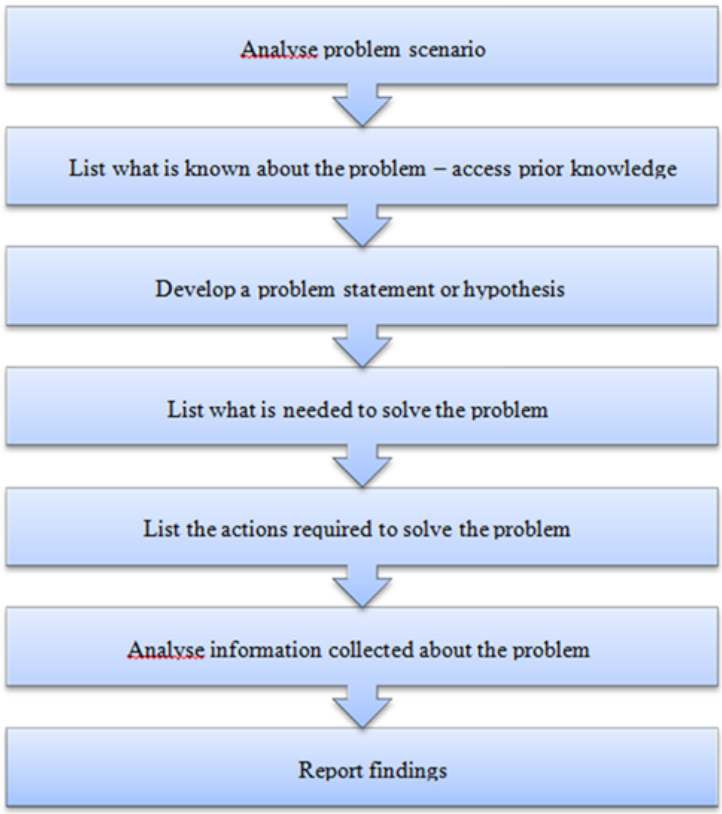


Figure 1.1: A problem-based learning approach (Wetzel, 2008)

The appeal of PBL is that the process purports to mirror the real world. Ill-structured "problems" (similar to what happens in professional practice) serve as vehicles for learners to identify what they need to know to be able to fully explain the presenting issues. As a group, learners generate and support hypotheses they have proposed, identify gaps in their knowledge and understanding and then undertake a period of self- directed study before they return to apply what they have learnt to their initial problem. The expected outcomes of PBL after working through this process are shown in Figure 1.2 (Barrows & Tamblyn, 1980).

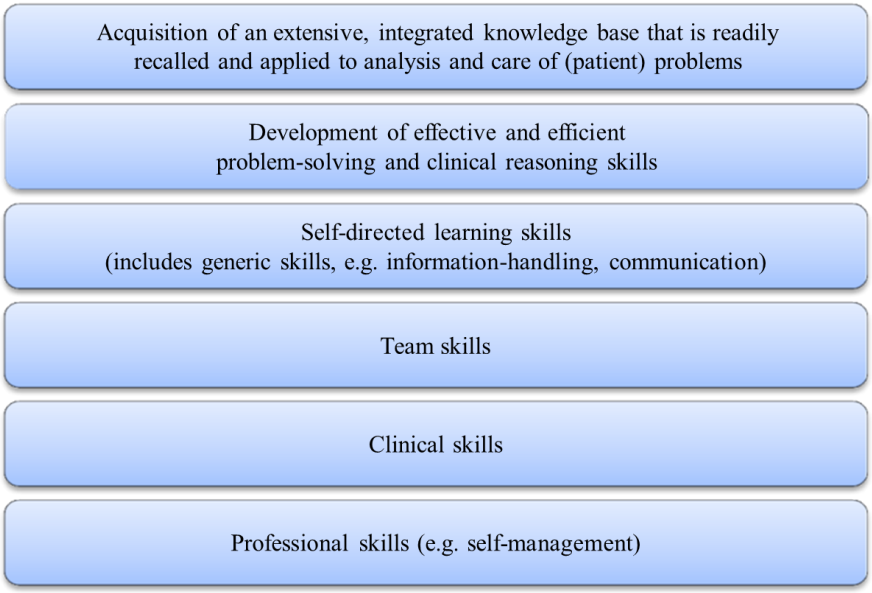


Figure 1.2: Expected outcomes of problem-based learning

PBL has, however, been criticized for not being based on theory (Colliver, 2000) and some studies have failed to show any advantages when students who have been taught using PBL and traditional curricula are compared in terms of the academic achievement (Mennin *et al*., 1993; Moore *et al*., 1994; Richards *et al*., 1996; Schmidt, 1996; Ripkey *et al*., 1998). A meta-analysis study carried out by Vernon and Blake (1993) showed that while there was no significant difference in student performance on miscellaneous tests of factual and clinical knowledge, students who had applied PBL performed significantly worse than their traditional counterparts on Part I of the United States Medical Licensing Examination (USMLE). Another study, however, found that PBL did not compromise performance on standard licensing examinations and that PBL may actually enhance performance (Blake *et al*., 2000). A study conducted on 305 First year students from three different psychology curricula compared the effects of a fully- fledged PBL environment to the effects of the conventional lecture-based learning environment, and combined lectures and other methods aimed at motivating students. The results of that study show direct positive effects of the learning environment on study progress, where students in PBL obtained more credits compared to students in more conventional curricula. Moreover, the levels of social and academic integration were also higher among students in the PBL curriculum (Severiens & Schmidt, 2008).

Taylor and Miflin (2008) explored our current understanding of PBL, addressing (amongst other issues) the conflicting evidence regarding its outcomes (Lohman & Finkelstein, 2002). They found that several factors influence the success of PBL. If there has been incomplete training of educators about the specific skills required in a PBL curriculum, the insufficient training and lack of expertise could result in a different interpretation and a poor understanding of PBL. Additionally, rushing the design of the curriculum may result in poor preparation, while insufficient staff training and purchasing a curriculum from another university and making major changes could also affect the educational purposes and outcomes (Azer, 2011), particularly in ways in which PBL has been implemented.

Of relevance to the present study where both graduates and school-leavers are accepted into medicine at Bond University, the graduate entry schools require completion of a baccalaureate degree in any discipline, and success in the Graduate Australian Medical Schools Admissions Test (GAMSAT), which is designed, inter alia, to ensure a basic level of biological science knowledge. The policy of the medical school accrediting body, the Australian Medical Council in Australia and New Zealand, ensures that there is approximately 50% graduate and 50% school-leaver entry provisions in those two countries (Lawson *et al*., 2004). PBL was initially designed for graduate medicine, where all learners would have an undergraduate degree and would be regarded as mature students (Miflin *et al*., 1999; Carter & Peile, 2007). It was intended to be implemented for groups of students who have prior higher education.

Demographic characteristics are usually presumed to have an influence on the students' learning styles, perceptions and performance (Cariaga-Lo *et al*., 1996; Tang & Neber, 2008; Sultana & Bin Lazim, 2011). Medical students at Bond University students are of a diverse type of groups of students (i.e. local and international, males and females, graduate and school-leavers, younger and older students), where the observation of their verbal interaction in the PBL tutorials could contribute to the decision of assessing the applicability of a hybrid PBL program in a different region of the world with a multicultural environment, such as Kuwait.

1.4. Curriculum reform in the Dental Hygiene Program, College of Health Sciences (CHS), Public Authority for Applied Education and Training (PAAET), Kuwait

The population of Kuwait is highly multicultural, comprising of Kuwaiti citizens as well as immigrants from Asia and workers from many Western countries. PAAET was established on December 28, 1982 by law number (63) (KUNA, 2012) with the objective of developing and upgrading manpower to meet the shortfall in technical staff that occurred due to the industrial and economic development of the country. It was also tasked with developing the national technical manpower of Kuwait and aimed to meet the human resource needs of the country in two sectors: education and training. Growth in the healthcare industry has meant that College of Health Sciences (CHS) at the Public Authority for Applied Education and Training (PAAET) is preparing a growing number of students for careers in the fast-paced medical environment. Currently more than 1,000 students attend CHS. CHS is comprised of five programs: Nutrition Sciences, Medical Records, Lab-oriented Technology, Basic Sciences and Dental Hygiene. Dental Hygiene is a two-year program which includes theoretical, practical and clinical courses. CHS programs strive to achieve national and international recognition in healthcare fields. The main goal of the CHS is the exceptional preparation of health-related professionals. In the past, a conventional method has been used to teach and train students in this program but the predicted results and the clinical skills of the students were, however, not sufficient to achieve the objectives of the program. Faculty members become frustrated with the lack of preparation, research or administrative service skills necessary for academic success, specifically the lack of formal training of Dental Hygiene graduates. PBL has been shown to be an effective learning methodology in Western countries, some Asian countries and in few Arabian countries. It is therefore considered the methodology of choice to be implemented in dental hygiene department. As a student-centred method, PBL can aid teachers and contribute to the learning and training of the students while incorporating the objectives of the program to yield the desired outcomes.

The Dental Hygiene Department was established as part of the CHS in 1989 in

accordance with the recommendations of the Ministry of Health for the necessity of community oral health prevention and promotion personnel and to meet the 2020 World Health Organisation objectives. Enrolment was initially restricted to female students but in September 2011, the first male students were admitted. Only students who have successfully completed high school are allowed to join the program, with both Kuwaiti students and students from other nationalities able to enrol in this program. For Kuwaiti residents, the cost of tuition is paid for by the government. International students are either enrolled on a scholarship from their country or independently financed.

A dental hygienist is a licensed primary care professional, oral health educator and clinician, who work as a co-therapist with a dentist to provide preventive, educational and therapeutic services, supporting total health for the control of oral diseases and the promotion of oral health. In addition, she or he is a researcher who can become a significant part in the research field by implementing her or his knowledge and services.

Any potential case study to evaluate the appropriateness of PBL for the Dental Health Program at CHS needed to meet certain criteria. The student body should be diverse in terms of gender, age, educational background and culture and it must provide the college stakeholders with sufficient information to judge the possible success of PBL. The Bond University MBBS program therefore held appeal, as an undergraduate PBL program with a relatively diverse student population in terms of gender, age, educational background and cultural diversity (with home language taken to reflect cultural diversity). As the Bond University PBL model was successfully implemented, it allowed for the investigation of how challenges were identified and addressed and provided the opportunity to evaluate the curriculum design and implementation.

1.5. Institutional context: Bond University, Faculty of Health Sciences and Medicine's PBL program

Bond University introduced Australia's first fully private medical undergraduate

program in May 2005. The 4.6-year (four years and 8 months) program had an intake of approximately 90 students during the 2007-2009 study period, of which approximately 60% were school-leavers and 40% post-graduates. Approximately 2% of this intake comprises international students. At the time of the study, students spent the first 2.3 years (two years four months) of the medical undergraduate program primarily on campus (Table 1.1), completing Phases 1 and 2, before commencing their clinical training in local hospitals and health care settings (Phases 3 and 4).

Teaching and learning in the first half of the program (Phases 1 and 2, see Table 1.1) uses a PBL-based structure, where each week, students study one case that is supported by lectures, practicals, tutorials, web-based learning and clinical skills training. The cases were mostly purchased from another Australian university but several cases were written to address Bond's specific requirements for the first year of an undergraduate course. The duration of the preclinical phase of the program is seven semesters (84 weeks).

The attributes important for Bond University undergraduate medical students develop are the acquisition of knowledge through group learning as well as communication skills, team work, problem solving, self-directed learning, sharing information and respect for others and their opinions (Bond University. Graduate attributes, 2013). In her study, Wood (2003) indicates that the facilitation of group learning can be achieved by combining and adopting those desirable attributes, such as communication skills, teamwork, problem-solving, independent responsibility for learning, sharing information and developing respect for others.

Table 1.1: The four phases of the Bond University MBBS Program

Phase	Semester/weeks	Focus
1	Semesters 1-3 (3 x 12 weeks)	35 PBL cases are examined (all except one, two-week case are one-week long). The emphasis is on studying basic sciences, which are integrated into the PBL cases. Additionally, students develop communication, history-taking and procedural skills.
2	Semesters 4-7 (4 x 12 weeks)	PBL cases are based on the body systems, with 2- 4 cases in each system block. Students develop clinical reasoning skills and further develop their existing history-taking, physical examination and procedural skills.
3	13-week Integrated clinical semester (57 academic weeks)	7 x 6-week clinical rotations. 1 week revision
4	44 academic weeks	Further rotations and electives in the clinical setting.

Bond University has adopted a hybrid PBL process in which the weekly cases that open on Monday and close on a Friday (both two-hour sessions) are supported by lectures, clinical skills training, practical sessions and sometimes community placements. There are two tutorials a week (on Monday and Friday) which run for approximately two hours each, supplemented with between 8 and 10 lectures each week that are conducted by faculty, adjunct faculty or invited external clinicians. A matrix of the weekly learning outcomes is released each Monday after the first tutorial, along with required readings, lecture notes and supplementary materials. The process and skills of PBL at the time of the study is shown in Table 1.2.

Table 1.2: The process and skills of PBL tutorials during a week in the Bond Medical Program

Day 1 (Monday)	Self-Directed Learning (SDL)	Day 2 (Friday)
• The case is shown to the students for the first time • Case "triggers" sequentially revealed • Group identifies their prior knowledge and experience when brainstorming the issues arising in the triggers • Students examine areas in which their knowledge is insufficient and develop learning issues	• Learning activities focus on addressing the identified gaps in knowledge, skills and critical thinking • Private study	• Students reconvene • Share their knowledge • Summarise and report on what they have learnt • Use their cognitive skills by engaging in a variety of processes focused on problem • Test their hypotheses • Validate their decisions that lead to determining and justifying the most reliable diagnosis • Adopt well-developed communication skills and teamwork within the PBL group

A typical hybrid PBL tutorial consists of a group of students (usually between seven and 10) and a tutor who facilitates the session. Those groups work together for the whole semester. A group needs to be together long enough to allow effective group dynamics to develop so that cooperation and collaboration with others becomes inherent (Wood, 2003). Groups have two functions: to complete student and curricular tasks and to fulfil group members' social and emotional needs (Mennin, 2007). Assessment of the students was based on this matrix. In Phase 1, students' performance is evaluated against the weekly matrix of learning outcomes on three occasions over the course of each semester. This linking of the learning outcomes to the scheduled activities is carried out through the PBL tutorials.

1.6. How this research project fits

In this study, the researcher analyses the PBL experience itself, using the views and learning oriented utterances of the students, and investigating the influence of several factors within the PBL experience on those students, while determining the association between those factors. Moreover, detecting an association between students' learning oriented utterances during PBL tutorials and their academic performance is another objective achieved though this study.

1.7. Overview of the study design

This study used largely quantitative methods, supported to some extent by qualitative methodologies to evaluate the effect of several learner demographic variables (gender, age, education background, home language) on:

- Students' attitude towards PBL (Part A)
- Quality of verbal participation during PBL tutorials (Part B)

Prior knowledge, home language and age are independent variables most likely to impact on the dependent variables such as attitudes of learners towards PBL and verbal interaction in the PBL tutorials. The study comprised two parts: Part A and Part B. Part A used a cross-sectional approach involving the medical students in Years 1-3 commencing 2007 and concluding in 2009, as well as a longitudinal approach involving Year 1 of the 2007 cohort as well as the following years of their study (2008 and 2009). The study investigated the likely impact that prior knowledge, home language and age have on the attitudes of learners towards PBL and PBL tutor practice.

Part B uses a validated instrument to quantify different types of argument and questioning, supported by qualitative methods (Visschers-Pleijers, 2006; Visschers-Pleijers *et al*., 2003; 2006) (detailed explanation of this instrument and its use in Chapter 4). This cross-sectional part of the study sought to quantify the utterances of Year 1 and 2 students and their tutors during PBL tutorials, with the view to establishing whether a correlation exists between participation and final end of phase or year academic grades.

Figure 1.3 displays the study design of Part A and Part B of the study that was used to test the hypothesis and to answer the research questions.

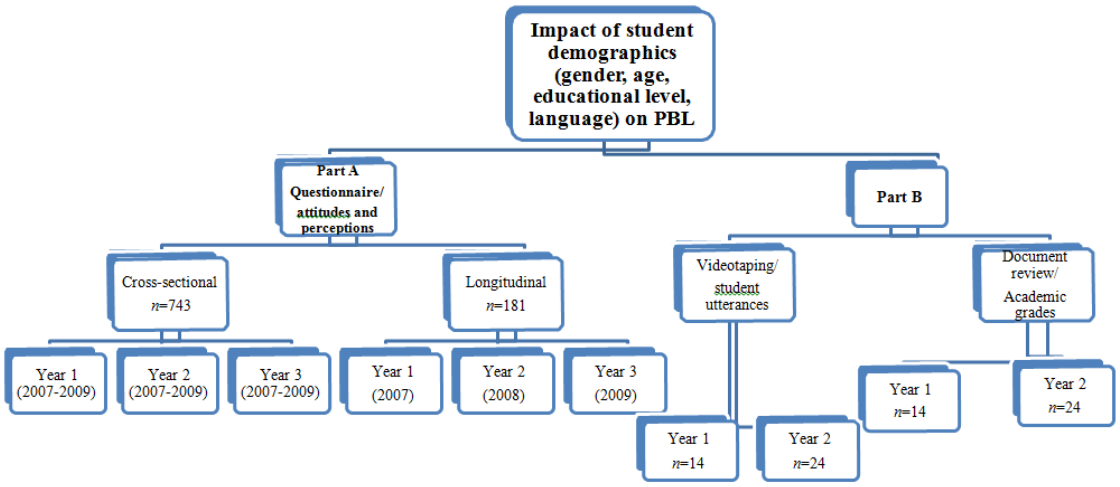


Figure 1.3: Study design for Part A and Part B

1.8. Hypothesis and research questions

This research hypothesizes that demographic factors such as gender, age, education level and home language do not influence student perception and learning in PBL. This thesis tests this hypothesis in order to determine the appropriateness of PBL for a Dental Hygiene program in Kuwait, using Bond University's medical program as a case study. Moreover, assessing the PBL success by examining the effect of students' demographics on their perception, participation correlated with their academic achievement and projecting the results of this study in order to contribute to assessing the decision of the utility and applicability of this PBL experience to Kuwait dental hygiene program.

To test the hypothesis, several research questions were developed. The anticipation of no influence of demographic characteristics such as gender, age, education level and home language on the students' perceptions of PBL, the verbal interaction of the students during PBL tutorials and the association between the students' academic achievement and their utterances will be examined in this project. The relevance of these assumptions to the literature will be discussed in detail in Chapter 2.

The first part of the research, Part A, used a questionnaire to explore the perceptions of students toward the PBL process according to their demographic characteristics.

The following research questions, RQ1, and RQ2 were investigated:

- Research Question 1 (RQ1): Do gender, age, education background and home language affect students' perceptions of PBL?
- Research Question 2 (RQ2): Does students' perception of PBL change as they progress through their studies (as measured in the students' first, second and third years of study) with consideration of the four demographic characteristics?

It is assumed of students' demographics will have no influence on their perception of PBL. A change is anticipated in students' perceptions of the PBL process as they progress in their studies from one year of study to the next and also in students' perceptions of the PBL tutor practice as they progress in their studies.

The second part of the research, Part B, investigated the effect of demographic characteristics on the utterances of the students during PBL tutorials using a validated instrument (Chapter 4). Learning-oriented utterances were videotaped and analysed to ascertain students' verbal engagement (quantitative and qualitative) in PBL as well as the effect of tutor intervention to answer the following research questions:

- *Research Question 3* (RQ3): Do gender, age, educational background and home language influence the quantity and quality of student utterances during PBL tutorials?
- *Research Question 4* (RQ4): Does tutor intervention during the PBL tutorials affect or influence student utterances?
- *Research Question 5* (RQ5): Is there an association between the students' utterances during PBL tutorials and their academic achievement?

The end of year assessment scores were correlated with the results of the analysis tool.

1.9. Organisation of the thesis

This thesis comprises five chapters. Chapter 1 introduced the study and outlined the

context and rationale, as well as describing the theoretical framework of the research. Chapter 2 summarised our current understanding of PBL as a learner-centred educational approach in relation to the literature and presents the research questions of this study.

Chapter 3 describes the details of the study design for the first part of the study, Part A (a questionnaire). The development and validation of the questionnaire will be discussed as well as sample recruitment and data collection. Additionally, it will illustrate and analyse data collected, which examines views of students towards the PBL process. Moreover, an in-depth analysis of the results of Part A, outlining the influence of demographics on the students' perception of PBL, as discovered in this part of the study, using two approaches: cross-sectional and longitudinal. Further, the findings of this study will be discussed in terms of the current literature.

Chapter 4 describes the details of the study design for the second part of the study, Part B (an observational inventory). This Chapter will discuss the selection of the instrument, describe the participants and data collection and display the resultant data of the instrument used to analyse student and tutor utterances. This Chapter then identifies the influence of demographic characteristics on student participation as well as the influence of tutor intervention on students' verbal interaction and the correlation between students' learning-oriented utterances and their end of year assessment grades. Again, the results will be discussed in terms of the current literature.

Chapter 5 synthesizes the findings of this research, highlighting the implications of the results in terms of how this study has advanced our understanding of the impact of student diversity on PBL. The limitations of the research are identified and recommendations for further study are suggested.

1.10. Concluding comments

In response to a proposal to establish a PBL Dental Hygiene program in Kuwait, this PhD study investigates the influence of student demographics (gender, age, education level, home language) on the perceptions of and participation in PBL

tutorials in a diverse cultural context. The study examines the PBL process itself, students' attitudes and utterances and the group dynamics of PBL tutorials. The effect of the tutor on student discussion during PBL tutorials is also examined. This thesis outlines the study proposal, including the research questions, a hypothesis related to the study, a literature review, the methodology used, results and discussion and concludes by identifying future development required supported by a list of tables and references.

This Chapter has introduced the context for the research and provides an overall discussion into the process and conduct of PBL in medical programs. The next chapter presents in more detail a review of the relevant literature that supports the design and implementation of the study.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

Chapter 1 introduced the context and the rationale for this study. The case study examined is the undergraduate medical course at Bond University, Queensland. The student diversity at Bond University means it is a useful case study to explore the decision to implement PBL in a Dental Hygiene program in the College of Health Sciences at Kuwait. This Chapter presents a review of the literature on PBL.

2.2. PBL philosophy

Medical education in the 21st century is significantly different from the days when students were taught in a didactic, teacher-led manner and were required to regurgitate facts and formulae. Most modern medical programs are based on andragogy: the principles of adult learning (Knowles, 1980). These include learning in a clinical setting and the application of Constructivist Theory (Vygotsky, 1978), both of which require students to be intellectually engaged and to incorporate critical reasoning processes and reflective practices into their learning (Tearle *et al*., 1999). Our growing understanding of how learning is supported, both for oneself and for others, continues to support a move from purely didactic teaching to a more collaborative and cooperative approach, such as PBL.

As was discussed in Chapter 1, the primary purpose of PBL is to stimulate the acquisition of knowledge in a patient case practice scenario. This incorporates the constructive learning approach in a PBL context. Constructive learning is the acquisition of shared understanding and knowledge results from collaborative, cooperative social learning in the situation of a small homogenous group that discusses a simulated case set in a professional context that resembles the future practice of graduates. The patient case and its selection are therefore important in the success of the PBL process (Barrows & Tamblyn, 1980). Whilst prior knowledge is needed to make an inference or to form a hypothesis, it is the application of knowledge in a case into diagnosis and practice that replicates real-life case management clinically, for a doctor and therefore a medical student.

Another purpose of PBL is to make the learning process as contextually relevant and

experientially authentic as possible for adult learners. Institutions of higher learning and education had not previously recognised the importance of implementing adult learning models that assist students to demonstrate learning outcomes in a variety of ways. Adult learners had not been credited with the maturity of their approach to learning and their requirements of the learning environment and experiences had often been ignored.

The PBL process includes a contextual, collaborative and constructivist learning environment (Czabanowska *et al*., 2012). The importance of this process is that it demands higher order thinking over content. Higher order thinking draws on the logical process of induction (observing and testing) and deduction, so that inferences about cause and effect can be tested formally as hypotheses. The Queensland Department of Education (2002) considers higher order thinking important because it involves the transformation of information and ideas by students. This transformation occurs when students combine facts and ideas and synthesize, generalise, explain, hypothesize or arrive at some conclusion or interpretation. Manipulating information and ideas through these processes allows students to solve problems, gain understanding and discover new meaning.

PBL is popular in medical and nursing education because in those courses students are frequently required to be intellectually engaged in thinking when encountering problems that need to be solved and that kind of thinking is a required on-the-job skill in many medical fields. PBL has been shown to be more effective than traditional teaching for helping students to make links between the basic sciences and their clinical work with patients (Barrows & Tamblyn, 1980).

2.3. Effective implementation of PBL

Both students and tutors can behave in a manner that is counterproductive to the PBL process if not properly inducted to the procedures required. This is supported by Visschers-Pleijers, Dolmans, Wolfhagen & van der Vleuten (2005), who conducted a questionnaire-based study that investigated the degree to which group dynamics, exploratory questioning, cumulative reasoning and conflict resolutions

strategies affected the implementation of the PBL process. They found that PBL with poor implementation is likely to have poor effectiveness on the development of students' cognitive skills.

Both the content and the steps that students follow during PBL are significant in the acquisition of information through the PBL process. The facilitator needs to be aware of this. Therefore, effective implementation is very important not only to develop the right learning environment but in helping to determine how content is best delivered.

2.4. Factors contributing to effective learning in PBL

There are a number of factors that contribute to the effectiveness of PBL. These include the problem (case) used, the tutor or facilitator and the students. In this study, student demographics were explored as factors contributing to attitude towards and participation in PBL.

2.4.1. Cases

Cases are the driving force behind students' independent study in PBL (Dolmans *et al*., 1997). When developing a PBL program, planning the cases and linking the problems to the clinical context is important, as the nature of student learning is to a large extent dependent on the quality and appropriateness of the cases (Dolmans *et al*., 1993).

Cognitive research and practical experience with PBL have led to improvements in identifying the characteristics of a good problem (Barrows & Kelson, 1995; Gallagher *et al*., 1992; Kolodner *et al*., 1996). A good problem provides feedback that allows students to evaluate the effectiveness of their knowledge, reasoning and learning strategies. The problems should also promote conjecture and argumentation. The cases in a PBL curriculum are selected so that ideas are visited in a number of problems across the entire curriculum (Hmelo-Silver, 2000; Koschmann *et al*., 1994). To obtain maximum benefit from the PBL process, there are a number of requirements that the problems must have. Good problems often require

multidisciplinary solutions and allow students to gather and see how knowledge is a useful tool for problem-solving while also fostering communication skills when students present their plans to the rest of their class (Derry *et al*., 2002; Hmelo-Silver, 2000). As students generate hypotheses and defend them to others in their group, they publicly articulate their current state of understanding, enhancing knowledge construction and setting the stage for future learning (Koschmann *et al*., 1994). To foster flexible thinking, problems need to be complex, structured and open-ended. The problem solutions should be complex enough to require many interrelated pieces and should motivate the students need to know and learn. In order to support intrinsic motivation, they must be realistic and resonate with the students' experiences. They must also address cultural, ethical and moral issues to enhance respect to people in the group from diverse cultures and belief systems (Loudon *et al*., 1999; Nunez, 2000; Crosson *et al*., 2004).

2.4.2. Students

Students use their cognitive skills by engaging in a variety of processes focused on problem solving, which test their hypotheses and validate decisions that lead to determining and justifying the most reliable diagnosis. A review of PBL literature from 1972 to 1992 indicates that while students enjoyed interacting in a PBL format more than a conventional format and performed as well on clinical and faculty evaluation as their traditional counterparts, they did not necessarily perform as well on basic science examinations and in the cognitive assessment of aggregate medical knowledge (Albanese & Mitchell, 1993). These conclusions were supported by the meta-analysis study conducted by Vernon and Blake that reported that there was no significant difference in student performance on miscellaneous tests of factual and clinical knowledge, but that PBL students performed significantly worse than their traditional counterparts on Part I of the United States Medical Licensing Examination (USMLE) (Vernon & Blake, 1993).

A subsequent review of PBL studies and several meta-analyses from 1974 to 2006 conducted by Walker and Leary (2009) indicates that across almost all of the analyses, PBL students either did as well as or better than their lecture-based

counterparts and they also tended to do better when the subject matter was outside of medical education, a result that is strengthened by multiple regression analysis. The regression analysis was used to determine the ways in which self-directed learning and motivation variables combine to impact cognitive outcomes. Specifically, this involved backward elimination linear regression with effect size (weighted by sample) as the dependent variable, and assessment level, problem type, PBL method and discipline as the predictors (Walker & Leary, 2009). The variation in these results may be due to the different ways that PBL is implemented, as if an authentic process is not followed, PBL"s effectiveness will be affected.

One of the goals of PBL is to help students become effective collaborators. There is little research that examines this directly. Collaborative problem-solving groups are a key feature of PBL and existing research has instead focused on factors that affect how well students learn collaboratively. One assumption about PBL is that the small group structure helps distribute the cognitive load among the members of the group, taking advantage of group members' distributed expertise by allowing the whole group to tackle problems that would normally be too difficult for one student alone (Pea, 1993; Salomon, 1993). The notion of distributed expertise is particularly relevant in PBL because, as the students divide up the learning issues, they become "experts" in particular topics and help each other learn. Furthermore, research suggests that the small group discussions and debate in PBL sessions enhances problem-solving and higher order thinking and promotes shared knowledge construction (Blumenfeld *et al*., 1996; Brown, 1995; Vye *et al*., 1997). In PBL groups, the students often work together to construct collaborative explanations. Most PBL groups, however, need some help to collaborate effectively and in the traditional PBL model (i.e. Barrows, 2000), a facilitator helps ensure that all students are involved in the discussion.

2.4.3. The PBL tutor

With PBL, the tutor (also called the facilitator) takes an active role in directing and guiding students about how to tackle the case study problems by asking questions to keep the group focused on relevant issues. The tutor asks Socratic questions -

thoughtful questions that enable the student to examine his or her ideas logically and to be able to determine the validity of those ideas – with a number of aims. These include to motivate the students to discuss only information and ideas relevant to the case; provide triggers for the case; guide the thinking of students; focus the group activities on issues relevant to the problem; use the tutorial to discuss the case or the problem only and discourages non-relevant issues; and aid the students in resolving conflicts in the group through the application of certain behaviour that is dedicated for resolving conflicts that occur during the tutorials.

In PBL, the tutor or facilitator is an expert learner, able to model good strategies for learning and thinking, rather than an expert in the content itself (Hmelo-Silver & Barrows, 2003). The facilitator is responsible both for moving the students through the various stages of PBL and for monitoring the group's process. This monitoring assures that all students are involved and encourages them both to externalise their own thinking and to comment on each other's thinking (Hmelo-Silver, 2002; Koschmann *et al*., 1994). The facilitator plays an important role in modelling the problem-solving and self-direct learning (SDL) skills needed for self-assessing one's reasoning and understanding.

Facilitation is a subtle skill. It involves knowing when an appropriate question is called for, when the students are going off-track and when the PBL process is hindered. In a study of an expert PBL facilitator, Hmelo-Silver (2002) found that the facilitator accomplished his role largely through metacognitive questioning that focused students' attention and elicited causal explanations. From this study, Hmelo-Silver (2002) concludes that the expert facilitator must have a flexible set of strategies that can be tailored to different stages of the PBL process.

The small group size characteristic to PBL is believed to be an effective method for increasing students' classroom engagement (Duch *et al*., 2001), however, this group interaction cannot be achieved unless a skilled facilitator who can promote a relaxed tutorial atmosphere is present. In one study, the students in a surgery clerkship said that two important skills that they would like the PBL tutor to possess are helping students identify important issues and providing feedback to students while

encouraging feedback from the group (Mayo *et al*., 1993). These results emphasize the need for the facilitator to be properly trained as well as skilled and effective.

The facilitating skills and content knowledge of the tutor are skills that a PBL organiser must consider when selecting tutors in order to achieve the desired outcomes of PBL tutorial sessions (Bochner *et al*., 2002). Graham *et al*., (2002) report that tutors who had excellent communication skills but were from a non-science background were rated just as highly by students as tutors who had medical training. Likewise, a study conducted at the Fu-Jen Catholic University, Taiwan, found that students preferred a tutor who had knowledge in both basic and clinical science areas (Lin, 2005). Schmidt *et al*., (1993) found that students guided by content experts spent more time on self-directed study and had better achievement than those led by non-experts. These findings show the importance of having a knowledgeable tutor who is able to maintain the facilitator role.

The role of the tutor who facilitates in a different culture than his or her own was investigated by Das *et al*., (2002). This study evaluated students' perceptions of tutors in PBL tutorials. The findings showed that differences such as differences in cultural and/or religious experiences and expectations inhibited interaction among the students and between the students and the tutors. The study also found that gender differences were perceived as significant in terms of students achieving their learning outcomes. For example, female students gave higher scores towards tutor skills than male students and in PBL tutorials female students sought the facilitation of expert tutors, who would fill in knowledge gaps. Female students from the UAE have been described as more concerned than male students about proving themselves academically. Das and colleagues' study of Emirates students (2002) suggests that PBL tutors need training in understanding cultural differences and how male and female students respond to tutors from different ethnic backgrounds. The behaviour and ability of tutors can be factors that influence PBL group interaction and which encourage the cognitive engagement of students, thereby affecting the outcomes of PBL.

2.5. Positive outcomes of PBL

The literature has found several key benefits to PBL: knowledge, educational environment and satisfaction and group work and the development of higher order thinking skills such as problem-solving, critical thinking and self-directed learning. These benefits are explored in the following section.

2.5.1. Contextual knowledge

Some studies show that the knowledge advantages of PBL for students are two-fold. Firstly, PBL students had better results on medical knowledge tests compared to lecture-based students (Login *et al*., 1997). Secondly, the process by which PBL allows students to develop their knowledge is beneficial for learning. In the problem-solving segment of PBL tutorials, students activate and explore their pre-existing knowledge using a systematic process of discussion and exchange in the context of the problem (Norman & Schmidt, 1992; Schmidt, 1993). A brainstorming process is then used to discuss the problem(s), with students suggesting possible explanations on the basis of prior knowledge. Based on their prior knowledge, learners actively construct explanatory models, which in turn facilitate the processing and comprehension of new information. Thus, preliminary discussion in the small group should help students mobilise whatever knowledge is already available (Schmidt *et al*., 1989).

2.5.2. Educational environment and satisfaction

The small group learning of PBL creates a supportive learning environment that encourages risk-taking. John Dewey is a key figure in the field of education and has made the most significant contribution to and influence on the development of educational thinking in the 21st century. He argued that education and learning are social and interactive processes. He believed that students thrive in an environment where they are encouraged to experience and interact with the curriculum, independently discovering meaning within the subject area and where they can relate the information discovered to prior experiences, making connections with what is known to that which needs to be understood (Dewey, 1938). His thinking paved the way for the development of a PBL approach.

PBL students have been found to be more satisfied with their learning experiences than non-PBL students (Norman & Schmidt, 2000). Students report enjoying the small- group interactions and the collegial atmosphere associated with PBL. Use of PBL has been found to increase class attendance and decrease student distress, including depression, anxiety and hostility (Norman & Schmidt, 2000).

2.5.3. Group work

The group format of PBL is a fruitful environment for students to improve their attitudes and collaborative skills. This occurs in PBL tutorials when one student reads the case or problem along with the triggers provided. The other students engage in a stream of focused discussions in order to think collaboratively about the problem and to make informed and appropriate decisions that provide solutions. Co-operation within the group progresses both the group's and the individual's learning. Mennin (2007) states that groups have two functions: to complete student and curricular tasks and to fulfil group members' social and emotional needs. Learning outcomes and intrinsic motivation are influenced by group work (Schmidt & Moust, 2000). Therefore, group work is one of PBL's key benefits.

2.5.4. Higher order thinking skills

The final benefit of PBL discussed in this thesis is the development of students' higher order thinking skills (De Grave *et al*., 1996). PBL is now recognised as an effective process for learning and how to best utilise and implement PBL is of interest to many medical educators, yet aspects of PBL still need evidence of their success. This research aims to address that lack through investigating the effect of student demographics on PBL. Medical professionals have long understood that due to the nature of medical practice and diagnosis, problem-solving techniques involving higher order thinking skills as important for effective learning as information retention (Norman & Schmidt, 1992; Schmidt & van der Molen, 2001). Arts, Gijselaers and Segers (2006) report that the use of effective instructional design techniques enhances the problem-solving techniques, particularly knowledge acquisition and use as well as inductive reasoning, problem solving and diagnostic accuracy. It is therefore important to understand how process can be influenced by a

well-designed product and to recognise that if the PBL course is not designed well, the learning outcomes will be affected.

Furthermore, educational approaches are thought to have facilitative or hindering effects on the students' critical thinking development. To test this hypothesis, Tiwari, Lai, So and Yuen (2006) compared the effects of PBL and lecturing approaches on the development of students' critical thinking using the California Critical Thinking Disposition Inventory (CCTDI) and found that the PBL students showed significantly more improvement in overall CCTDI than other lecture approaches. The findings of Tiwari and his colleagues (2006) recognise how the PBL process can motivate and enhance students' critical thinking.

Many investigations have indicated that competence is fostered not primarily by teaching to deliver knowledge or teacher-centred approaches, but through teaching to engender specific kinds of cognitive activity (Glaser, 1991). All too often, teacher-centred approaches force students to answer questions that they would never themselves have asked. In contrast, students should be actively engaged in acquiring knowledge and should define to a large extent themselves the content to be mastered. Likewise, developing self-directed learning skills is a process that involves interaction with all kinds of knowledge resources and is not limited to the tutorial group. Consequently, developing as a self-directed learner requires a variety of learning experiences incorporating a range of learning styles (Marton & Booth, 1997; Silén, 2003).

2.6. Educational evidence supporting PBL as an educational approach

Instruction is often designed based on the assumption that learning is "a similar process in all individuals and for all tasks and thus many people feel a common instructional approach should suffice" (Clark, 2000, p. 31). PBL is not the only successful strategy that can be utilised to achieve effective learning in ill-structured and complex domains. The results of the qualitatively synthesizing meta-analyses of PBL investigated by Strobel and van Barneveld (2009) for preparation for the

workplace indicate, however, that PBL is significantly more effective than traditional instruction for training competent and skilled practitioners and to promote the long-term retention of knowledge and skills acquired during the learning experience or training session.

A number of studies have shown that PBL is an effective way of integrating the basic sciences into medical courses. PBL tutorials effectively facilitate the teaching of clinical and biomedical knowledge through the use of hypothesis-forming strategies in the small-group context (Patel *et al*., 2004). In medical education, PBL aims to meet three objectives (Patel *et al*., 2004):

- Organisation of biomedical and clinical knowledge around a patient case study scenario;
- Development of clinical reasoning processes; and
- Integration of scientific and clinical knowledge into a clinical problem context. These approaches of integrating the basic sciences into medical courses through PBL better meet the needs of students than that of solely traditionally taught classes.

One medical faculty in Germany replaced all didactic lectures with PBL. The acquisition in factual knowledge by students was investigated after this change and it was found that PBL did not result in students acquiring less factual knowledge than traditionally taught students (Antepohl & Herzig, 1999). Moreover, students in Antepohl and Herzig (1999) study reported that they considered PBL an effective learning method and preferred it to the lecture format. Students reported positive effects of PBL in terms of the use of additional learning resources (Antepohl & Herzig, 1999), where they make more use of the library, journals and online searches and of self-selected as opposed to faculty-selected reading materials (Rankin, 1992). Students in that study also reported that PBL had a positive effect in terms of interdisciplinarity, team work and learning fun. This supports the findings that there is more active student participation, interaction and collaboration in small group tutorials (Wun, 2007).

There is increasing evidence that supports the hypothesis that active, experiential educational experiences (such as in PBL) are more transferable to learning and understanding for students than a passive, lecture-based instruction study (Hsieh &

Knight, 2008). Additionally, within the literature there is a broad consensus that PBL provides a more challenging, motivating, enjoyable and sociable approach to education than traditional didactic approaches (Claessen & Boshuizen, 1985; Warburton & Whitehouse, 1998; Connolly & Seneque, 1999; Norman & Schmidt, 2000; Haghparast *et al*., 2007)). In general, results showed that PBL had a favourable impact on students' perceptions of the academic learning environment (Lancaster *et al*., 1997; Lieberman *et al*., 1997).

2.7. Difference between PBL and traditional teaching outcomes

Although much research has been conducted on the traditional didactic teaching methods, there is no clear support for any superiority over other methods, however, when elements of the traditional didactic delivery are combined with the PBL process, producing what is known as a hybrid curriculum, a marked difference was noticed. Cheng, Alafris, Kirschenbaum, Kalis and Brown (2003) studied the examination performance by exploring the traditional versus PBL learning approach by looking at fourth-year Pharm.D students at a US university. Students were divided into two groups: Group A -students learned hyperlipidaemia using the PBL approach and thromboembolic diseases using the traditional learning (TL) approach, while Group B students learned hyperlipidaemia using the TL approach and thromboembolic diseases using PBL. Group A students scored statistically significantly lower on the total and analytical hyperlipidaemia (PBL) examination questions than did Group B, but scored similar results on the recall questions. Group A students scored statistically and academically significantly higher on the recall thromboembolic diseases questions, however, the scores for the analytical-thromboembolic diseases questions were not significantly different between the two groups. This suggests that certain topics are more suitable to be taught by PBL than others. The results of this performance examination indicate that some knowledge-based subjects might be better presented by PBL traditionally, suggesting that the merging or blending of both teaching methodologies may be more beneficial to the students than courses using only one approach.

Many medical schools internationally (including Bond University) use a hybrid

curriculum in which PBL is supported by lectures, practicals and other more structured learning activities. There are a number of studies that suggest this may be a better approach than a pure PBL curriculum (Blumberg & Michael, 1992; Houlden *et al*., 2001; Tsou *et al*., 2009). A lecture may have a fairly well-prepared structure for how to tackle a certain phenomenon with examples and pictures. PBL can build on and use that knowledge to link to and formulate a hypothesis, meaning the student receives benefits from both teaching methodologies. Wood (2003; 2008) surveyed the literature that evaluated the research relating to the effects of PBL on student learning, documenting the advantages and disadvantages discussed. Wood's (2003; 2008) results are presented in summary below in Table 2.1.

Table 2.1: Advantages and disadvantages of PBL (Wood, 2003; 2008)

Advantages	
Reason	**Description**
Deep learning	PBL fosters deep learning (students interact with learning materials, relate concepts to everyday activities and improve their understanding).
Constructivist approach	Students activate prior knowledge and build on existing conceptual knowledge frameworks.
Motivation	PBL is fun for students and tutors and the process requires all students to be engaged in the learning process.
Generic competencies	PBL allows students to develop generic skills and attitudes desirable for their future employment as medical practitioners.
Student-centred	PBL fosters active learning, improved understanding and the retention and development of lifelong learning skills.
Integration	PBL facilitates an integrated core curriculum.
Disadvantages	
Reason	**Description**
Role models	Students may be deprived of access to a particular inspirational, expert teacher who in a traditional curriculum would deliver lectures to the large group.
Information overload	Students may be unsure how much self-directed study to do and what information is relevant and useful.
Tutors must not teach	Tutors who enjoy passing on their own knowledge and understanding so may find PBL facilitation difficult and frustrating.

Human resources	More staff are required as part of the tutoring process than a traditional lecture-based system.
Limited additional resources	Large numbers of students need access to the same library and computer resources simultaneously.

By recognising the advantages and disadvantages of PBL, medical schools can implement PBL into the program so that learning outcomes can be achieved and factors that may affect PBL learning be addressed. These factors are discussed in the following section.

2.8. Factors affecting the PBL process

Previous research into PBL has recognized that several factors such as students' demographic characteristics, including gender, age, educational level and language, may affect the effective operation of a PBL tutorial (O'Hanlon, Winefield, Hejka, & Chur-Hansen, 1995; Walker, Bridges, & Benjamin Chan, 1996; Treloar, McCall, Rolfe, Pearson, Garvey, & Heathcote, 2000; Dyke, Jamrozik, & Plant, 2001; McLean *et al*., 2006; Woodward-Kron & Remedios, 2007; Singaram *et al*, 2008). In addition, student diversity may influence the efficacy of PBL tutorials (Omeri, 2003; Rienties & Tempelaar, 2013). While several factors have been reported to influence the PBL tutorial, not least case quality (Gijselaers & Schmidt, 1990; Schmidt *et al*., 1995; Dolmans, *et al*., 2005) and tutor skills (Schmidt & Moust, 1995; Chung, Yew & Schmidt, 2011), for the purposes of this study, the discussion will concentrate on the students' demographics.

2.8.1. Gender

Gender is one of the demographic characteristics that might have a substantial effect on students' learning as the literature states that typically in Western settings, male students tend to dominate discussions, with females being accommodating rather than dominating (Kaplowitz & Block, 1998). Females were more inclined to be "connected learners" who valued the social aspects of the learning context. Connected learning means that there is more emphasis on listening to achieve a deep

understanding of others' viewpoints rather than to verbally critique or dismiss them (Reynolds, 2003). Connected learning approach has "been traditionally denigrated in male-dominant learning environments, which are inclined to value more authoritative displays of knowledge and erudite critiques of others" findings and arguments" (Reynolds, 2003). In contrast, males felt more comfortable with individual and active rather than connected learning (Gilligan, 1982; Belenky *et al*., 1986; Gawelek *et al*., 1994). When exploring the views of male and female students on their initial experience of interprofessional PBL, Reynolds (2003) notes that PBL made a positive and well-received contribution to learning for both genders, indicating that PBL is able to support both learning styles.

The gender of students and tutors has been shown to have an impact on PBL. In one study, male students in a mixed gender groups were observed to dominate the discussion, speaking two and a half times longer than their female peers when there was a male tutor. When the tutor was female, the males' participation diminished significantly (Kaplowitz & Block, 1998). In another study, when the PBL groups consisted of men and women, some females felt isolated and ridiculed and this unsupportive atmosphere led some of them to withdraw, staying out of the discussion for the remainder of the tutorial (Krupnick, 1985). Other research suggests that females are often more sensitive to the interpersonal dynamics in PBL and their engagement and participation depends on feeling comfortable and positively connected to their colleagues (Fletcher *et al*., 2000).

Aries (1976) states that male students used this style of female behaviour (i.e. females being sensitive and feeling uncomfortable during PBL), to their benefit, in that they made negative comments to and about the females and had the chance to dominate the discussion. In an all-male PBL group, a hierarchical pattern of access to the discussion developed, with extremely uneven amounts of talk per man. In mixed groups, the male style dominated.

A study by Reynolds (2003), who looked at the experience of First year male and female occupational therapy and physiotherapy students during an interprofessional PBL module, focused on communication skills and patient-focused approaches to

care. Both female and male students stated that they felt able to express their opinions within the PBL tutorial group and were positive that their understanding of therapists‟ roles within the multidisciplinary team had increased. Females were, however, more positive than males in expressing trust in the information provided by other students. Females also reported greater enjoyment in taking responsibility for their own learning than did male students and had more positive views about working with students from another course. While the gender differences observed in this study were not substantial, they do support the hypothesis that gender is one demographic characteristic that may influence students' behaviour in PBL.

2.8.2. Age

Differences in the age and life experience of students will occur in PBL classes. Some mature-aged students indicated that they were thinking for and motivating the "kids‟ in their PBL groups (Teakle, 2008). A study by Aldred *et al*. (1997) indicates that mature-aged students seem to benefit more from PBL compared with younger students because they are able to draw on their greater life experiences and apply these to the PBL situations. This was to the detriment of some younger students, who stated that they thought that mature-aged students took more control and allocated simple (rather than complex) tasks to the younger group members.

In a study of UK mature-aged students, older students were less likely to use a surface learning style than deep learning style, in that they tried to understand the meaning of the material being studied and attempted to relate it to previous knowledge and personal experiences (McParland *et al*., 2004). The findings of these studies suggest that age is one demographic that can have an impact on PBL.

2.8.3. Tertiary education

Some studies have shown that the educational level of students can influence the performance of students in PBL. van den Hurk and colleagues (1999) found that first year students seemed uncertain about what should be studied and confined themselves to the content of the learning issues, but in later years, students studied more according to their own learning needs and interests (van den Hurk *et al*., 1999).

Connolly and Seneque (1999), , however, that, irrespective of the different starting points of students in a PBL program, the sharing and exchanging of information and ideas, including prior experiences, within the cooperative learning environment of the small group tutorial of PBL will contribute to the majority of students achieving the required learning outcomes. The results of these studies suggest that prior education may be a factor influencing a student's success in PBL.

2.8.4. Language

Language competency in instruction and interaction with peers is an important factor in learning. PBL was primarily developed in the medical school program at McMaster University in Canada in the late 1960s by Howard Barrows and his colleagues (Neville, 2009), where English is the most commonly spoken language. Therefore, PBL was taught and instructed in English. PBL spread to other countries where, even if English was not the primary language spoken in the region, it was the second language used in schools and in public. Of those regions, the Middle East did not identify or adopt PBL as an educational approach until the 1980s (Mpofu *et al*., 1998; Haghparast *et al*., 2007; Suleman *et al*., 2010).

Although the setting of PBL in small groups allows students to discuss problems freely with each other, some students might not be a significant contributor to the PBL discussion because of personal (withdrawn students), cultural, preparatory (didn't perform the self-search or read the related materials) or lack of interest (Krishnan *et al*., 2011) reasons.

One study examined four PBL groups in the Faculty of Medicine and Health Sciences (FMHS) at the United Arab Emirates University. The groups were observed in order to measure the degree of student interaction within PBL and to compare this with individual Test of English as a Foreign Language (TOEFL) scores and key background variables. The findings indicated that females adhered to interacting in English during group sessions while male students were more likely to revert to using Arabic to explore unclear phenomena. Additionally, males were less likely than females to correct one another's spelling and grammar (Mpofu *et al*., 1998).

The current study attempts to address language background as a reflection of culture in PBL in that if English is one's first language, one is assumed to come from a Western background and if one speaks Arabic they are from a Middle Eastern background. A study from the literature which evaluated student perceptions of PBL in two dental schools, one in Sweden and one in California, USA, found no measurable difference between students from different cultural, geographical backgrounds in relation to their acceptance of and success with PBL (Haghparast *et al*., 2007). In both of the study regions multiculturalism is a mainstream practice. This variable would be more fully tested with students who were from more traditional monocultures, where a non-Western approach is the mainstream culture. Singaram and colleagues (2008) find that students from different non-Western cultures (South Africa) enjoyed working with peers in PBL groups from different social and cultural backgrounds. Those authors found that the small-group PBL setting played a role in overcoming the cultural barriers and promoting unity and collaborative learning within diverse students groups.

In a study examining PBL within a Nepalese setting, Chapagain *et al*. (1998) found an intensive PBL-based introductory course in health sciences to be a useful and enjoyable method of learning. This success of PBL in a non-English speaking environment suggests that PBL is not a culturally-specific strategy and can also be successful in a non-Western culture, however, as the group of students examined were from a homogenous cultural background, a key point not addressed in Chapagain and colleagues' (1998) study is the response of a student from a different cultural group who is enrolled in a mainstream Western program where the student's gender, language and behaviour patterns may not be factored in or accommodated by the PBL context. The present study attempts to address this variable examining language background (as a reflection of culture) on PBL.

In a non-English-speaking region, cultural characteristics in PBL provided a dynamic discussion and evaluation environment when PBL was introduced in Medicine, Dukz Eylul University (DEU), Turkey (Gurpinar *et al*., 2005). After performing successfully as part of the medical program, PBL was also implemented in the faculties of Arts and Sciences, Education, Theology, Law and some

departments of the Faculty of Engineering, all of which had students with different cultural backgrounds. To avoid cultural differences, the DEU created their own original model, teaching students main health problems of the community, their prevention and ways of treatment with special emphasis given to the integration of knowledge, acquisition of professional and moral values and to the development of communication skills (Gurpinar *et al*., 2005), rather than adapt or copy any of the existing PBL models from another universities. The philosophical foundations of these models consisted mainly of John Dewey's philosophy of education and epistemology (Dewey, 1938). Dewey believed that students came to school to do things and learn in a community that gives them real, guided experiences that foster their capacity to contribute to society. He believed that students should be involved in real-life tasks and challenges. DEU recognised this and demonstrated, through the models they developed, that cultural differences can be accommodated in PBL.

2.9. International students at Australian universities

At the time of writing this thesis, Australia' s population is just over 23 million and is one of the most culturally diverse in the world with 24% of the population born overseas (Australian Bureau of Statistics, 2013). Over 200 different languages are spoken in Australia daily (Australian Bureau of Statistics, 2008).

Such diversity is also reflected in the higher education student population, where 27% of all tertiary students in Australia are international students (Australian Government, Department of Education, Employment and Workplace Relations, 2008). Engagement with such diversity has been shown to be positively associated with a variety of outcomes such as problem solving, ability to work with others and appreciation of and respect for diversity, however, this diversity can mean that students from many different cultural backgrounds which use different teaching methodologies are enrolled in the same course, leading to possible difficulties with expectation and learning style.

On reporting the successful incorporation of PBL into applied pharmacotherapeutics courses in the University of South Australia, an assessment of potential

disadvantages to student subgroups was carried out (Stupans *et al*., 2005). The comparison between international and local students and students from an English-speaking background and students from non-English speaking backgrounds yielded no clear trends of any one group outperforming the other.

In order to work in the medical field, students need to demonstrate their understanding through numerous real life, authentic experiences, using a variety of sources of information that have been validated and justified, by examining a range of perspectives, utilising diverse contexts, demonstrating expertise in collaborating and consulting both locally and globally to determine their "truth" and being able to justify their decisions (Tearle *et al*., 1999). These are the same attributes required of students participating in the PBL learning process and the attributes that most, if not all, Australian universities value and work hard to instil in their graduates.

The case study for this thesis is Bond University, Queensland. Bond University's Academic Senate and the Senior Management Group have endorsed a list of graduate attributes (Bond University, 2013) which underpin this philosophy, curriculum development and assessment at Bond University. These graduate attributes are listed in Table 2.2.

Table 2.2: Bond University graduate attributes

- Knowledge and critical thinking - a sound knowledge of their discipline and the ability to critically evaluate, manage, reflect on, integrate and apply it;
- Leadership, initiative and teamwork – the skills and initiative to contribute to their discipline or profession as an effective leader and as a member of collaborative, cooperative and successful teams;
- Communication skills – the skills to communicate effectively with their profession, their peers and the wider community; and
- Responsibility – the standards, ethics and values of their discipline, in both the local and global context

The attributes are embedded within all programs of study offered at Bond University, including the medical program. The graduate attributes are important to this study because they embrace the skills that are focused on by the students when

students were observed in their PBL sessions.

2.10. Concluding comments

The research on PBL continues and the findings confirm the fact that there is little, unequivocal evidence for how it works or its comparative effectiveness against other teaching and learning strategies. The literature review in this chapter has shown that despite the considerable work that has been completed on the implementation and effectiveness of PBL, no research has been done that looks at the impact of four student demographics on the perception of PBL. This research aims to address that gap.

This Chapter presented a review of the relevant literature. The literature review discussed other studies that focused on PBL and constructivist learning. It further explores research findings on the student demographic characteristics that influence the conduct and success of the PBL process. The next two chapters (3 and 4) present the methods, results and the discussion of Parts A and B of the study.

CHAPTER 3

PART A

STUDENT DEMOGRAPHICS AND PERCEPTIONS OF PBL

3.1. Introduction

The available literature on the influence of the demographics on students' perception of and performance in PBL (where perception is defined as the act or the effect of perceiving or insight or intuition gained by perceiving) was reviewed in Chapters 1 and 2. This Chapter investigates the influence of four demographic variables (gender, age, educational background, home language) on students' views of PBL. As there was no appropriate validated instrument available, a questionnaire was designed and validated (Appendix 1).

This aspect of the study will investigate the influence of demographic variables on students' views about PBL during the preclinical phase (Years 1-3) of their medical program at Bond University. The study comprises a cross-sectional component that collects data from three successive cohorts as well as a longitudinal component, in which a single cohort (Year 1 in 2007) was canvassed for three consecutive years. The primary purpose of this part of the study was to investigate whether gender, age, previous educational experience and home language influenced students' views about PBL as they progressed through their studies. It was decided that the most time- and cost-effective method to meet the primary purpose would be to use a questionnaire (Darby & Bowen, 1993).

This Chapter describes Part A of this research project: the development and implementation of a questionnaire that examines the influence of student demographics (gender, age, education level, home language) on perception towards different processes in PBL. A survey of the literature helped to identify these as the relevant demographics.

The first demographic variable examined was gender. The conversational styles of both men and women have been discussed in the literature and, while some stated that male students are the dominant participants in group learning, others claimed that females are connected learners and significant contributors and therefore might control the PBL discussions (Wijnia, Loyens, & Derous, 2011). Many studies claimed that males are more competitive speakers and are decisive, direct,

rational, logical, aggressive and impersonal (Krupnick, 1985; Heim & Golant, 1992; Tannen, 1994). This means they are more likely to engage in conflict (for example, by arguing, issuing commands and taking opposing stands) than their female counterparts, who were defined as co- operative, receptive, emotional and are likely to avoid conflict (Feinstein, 2006). Psychological studies suggest that such differences are due to differences in the linguistic environment of males and females (Crawford, 1995).

Age and educational background are two further demographic factors that have been identified as influencing factors on the students' attitude towards PBL. While PBL was designed mainly to meet the needs of graduate students (Taylor & Miflin, 2008), school-leavers were found to be more enthusiastic toward PBL learning tasks even though that type of learning process is often more unfamiliar to them than to older students (McParland *et al*., 2004). This may be because later-year (mature) students might not like to be told what and how to process their knowledge as they are already able to retrieve their previous knowledge outside the classroom. Studies also stated that mature-aged learners perceived PBL positively and were less likely to use a surface learning style (McParland *et al*., 2004). The final demographic factor examined was home language. While some scholars argue that students from different language backgrounds, for example those from a non-English-speaking Middle Eastern background, were known to be shy and were more used to the traditional learning environment (Krishnan *et al*., 2011), the review of the literature on PBL reveals that PBL is an enjoyable experience for students from a non-English-speaking background, as it allows them to work with their peers from different social and cultural backgrounds (Chapter 2). Additionally, students from different language backgrounds preferred the small group environment of PBL, as it encourages a focused interchange of knowledge and facilitates their adaptation to new and unfamiliar academic environments, allows for the evaluation and refinement of their learning by providing a setting for interaction with other individuals and provides collaborative feedback (Singaram *et al*., 2008; Fung, 2013), assisting the students in overcoming communication difficulties (Chapter 2). Learning equity among its diverse groups of learners is a mission that is advocated by Bond University (Bond University's Academic Senate and the Senior

Management Group, 2013).

3.2. Methods

This study used a mixed-method study with mainly quantitative methods, supplemented by a qualitative element. As no appropriate validated instrument was available, a questionnaire was designed and validated, which is described below.

3.2.1. Questionnaire development

The perceptions of the students (i.e. the point of views they have toward PBL) are important in evaluating the teaching and learning environment as the students' views form an important factor of the evaluation system of any learning innovation. Surveys or questionnaires can be objective instruments for collecting information about people's knowledge, beliefs, attitudes and behaviour (Oppenheim, 1992; Sapsford, 1999). Therefore, it was decided that a questionnaire would be appropriate for this aspect of the study.

As the primary aim of this part of the study was to investigate learners' demographics (gender, age, educational background, home language) and stage of learning on their perceptions of PBL, the first section of the questionnaire collected participants' demographic details, including their year of study (Years 1-3) (Appendix 1). The second section comprised the 16-item questionnaire comprising four subscales: skills development, group process, learning preference and tutor practice. A consent form explaining the purpose of the study was attached to the questionnaire (Appendix 2).

This part of the study was approved by the Bond University Research Ethics Committee and was registered under project protocol, RO 647 (Appendix 3). Following ethical approval, a survey instrument was designed to canvas learners' perceptions of various aspects of PBL. The questionnaire was developed through discussion between the researcher and the two supervisors who are experts in the education field, with many years of experience in developing similar instruments. It was agreed that the aspects of PBL that need to be canvassed to answer the research

questions and test the hypothesis were the skills developed during the PBL tutorials, group dynamics or process, students' learning preference and tutor's facilitation skills, leading to four subscales. The researcher and the two supervisors then independently generated between three and five items in each of the four subscales. Through discussion, the 30 submitted items were reduced to 19 based on the above mentioned criteria (Table 3.1) After conducting a number of statistical tests (described in 3.2.2.), the items were reduced to the 16 most relevant items (Table 3.2, Table 3.5, Appendix 1). It was not piloted amongst students as participants are all Year 1-3 students but a construct validation process (described in 3.2.3.) was undertaken once the questionnaire had been completed. Due to the limited timeframe, the survey was piloted with two PBL experienced teaching faculty and then constructively validated through several statistical tests (described in 3.2.3.).

Table 3.1: Final version of the questionnaire, comprising four subscales

No.	Statement	Subscales
1	I developed critical thinking skills through PBL tutorials	Skills Development
2	I developed problem-solving skills in PBL	Skills Development
3	I developed the ability to think laterally in solving problems in PBL	Skills Development
4	I have gained skills in making diagnosis in PBL	Skills Development
5	PBL enhanced my communication skills	Skills Development
6	PBL tutorials promote team work	Group Process
7	Everyone in my PBL group contributes significantly to the discussion	Group Process
8	The small group setting of PBL encourages the group to share their ideas	Group Process
9	I like sharing my knowledge with my PBL group	Group Process
10	I prefer PBL classes to didactic teaching such as lectures	Learning Preference
11	I learn better in a small group tutorial than in a large group lectures	Learning Preference
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	Learning Preference
13	My tutor promotes a relaxed atmosphere in PBL tutorials	Tutor Practice
14	My tutor asks lots of questions about the problem being solved	Tutor Practice
15	My tutor uses questions to keep the group on track	Tutor Practice
16	My tutor is good at resolving conflicts in the group	Tutor Practice

It should be noted that the reliability of an instrument is closely associated with its validity (Tavakol & Dennick, 2011). The following section explains how the reliability and validity of the questionnaire were determined.

3.2.2. Reliability

According to Tavakol and Dennick (2011), reliability and validity are two vital elements in the evaluation of a measurement instrument such as the questionnaire. Cronbach's alpha was the statistical measure used to determine the reliability of the four subscales: skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP), while a three-step process was used to establish the construct validity of the instrument. The steps were:

1. A parallel analysis based on Principal Components Analysis (PCA) to determine the number of underlying factors (Hoyle & Duvall, 2004);
2. Principal Axis Factoring (PAF)-(Blue *et al*., 1998; Williams & Webb, 2013) to determine which items loaded on which factor; and
3. Confirmatory Factor Analysis (CFA)-(Child, 1990; Hoyle, 2000; Thompson, 2004) to confirm the structure identified in Step 2 (PAF).

As mentioned earlier, a major concern when a questionnaire or psychological test is used to measure attributes or behaviour is that of reliability (Rosenthal & Rosnow, 1991). Reliability provides the researcher with assurance that the test consistently discriminates individuals at one time or over a course of time, i.e. that measurements are repeatable when different individuals perform the measurement on different occasions under different conditions with supposedly alternative instruments which measure the same construct (Rosenthal & Rosnow, 1991). Reliability therefore means that there will be consistency of measurement. Alpha was developed by Cronbach in 1951 to provide a measure of the internal consistency of a test or scale, and Cronbach's alpha coefficient was used in this study to measure reliability. The value for Cronbach's alpha is located between 0 and 1 and clarifies the extent of correlation between answers. The closer Cronbach's alpha coefficient is to 1, the greater the internal consistency of the items on the scale. The accepted value of Cronbach's alpha as an indication of reliability is between 0.7 and 0.8. Substantially lower values indicate an unreliable scale (Miller, 1995). George and Mallery (2003)

provide the following guidelines for the reliability values for Cronbach's alpha:

- ≥ 0.9: Excellent,
- 0.8-< 0.9: Good
- 0.7-< 0.8: Acceptable
- 0.6 -< 0.7: Questionable
- 0.5-< 0.6: Poor

Applying the inter-item correlation matrix yielded positive values for the Cronbach's alpha value for each questionnaire item, indicating that the items were measuring the same underlying characteristics. Cronbach's alpha was then checked for each construct or subscale (column 4, Table 3.2). After that, the item-total statistics was applied to indicate with which each item correlates with the total score (column 3, Table 3.2). Resultant values lower than 0.3 indicates that the item is measuring something different from the scale as a whole (Pallant, 2011). In this test, all values were above 0.3. If these values are lower than the Cronbach's alpha value of construct (column 4, Table 3.2), then this means that the items of the four questionnaire constructs or subscales are internally consistent and reliable and no one single part could be omitted without affecting its reliability. Table 3.2 shows that the Cronbach's alpha values of items are positive and lower than the Cronbach's alpha of construct.

Table 3.2: Cronbach's alpha coefficient of items and constructs of items for the questionnaire

Construct	Item	Cronbach's alpha value for construct if item deleted	Cronbach's alpha value for construct
Skills development (SD)	SD1	0.82	0.83
	SD2	0.75	
	SD3	0.77	
	SD4	0.82	
	SD5	0.80	
Group process (GP)	GP6	0.72	0.74
	GP7	0.62	
	GP8	0.73	
	GP9	0.64	
Learning preference (LP)	LP10	0.75	0.77
	LP11	0.65	
	LP12	0.65	
Tutor practice (TP)	TP13	0.60	0.77
	TP14	0.70	
	TP15	0.73	
	TP16	0.63	

George and Mallery (2003) note that an alpha value of 0.8 is a reasonable goal to ensure more internal consistency between the scale items. While a high value for Cronbach's alpha indicates that there is good internal consistency with the items in the scale, it does not mean that the scale is unidimensional. Factor analysis is also required to determine the dimensionality of a scale.

3.2.3. Questionnaire validation

Validity is concerned with the extent to which an instrument measures what it is intended to measure (Tavakol & Dennik, 2011). In this aspect of the study, the questionnaire will be validated using the construct validity which is traditionally been defined as the experimental demonstration that a test or instrument is measuring the construct it claims to be measuring (Messick, 1988, 1989). The construct validity of an instrument should be demonstrated by an accumulation of evidence thus several tests were used to provide the construct validity of this instrument. In order to test the construct validity of the questionnaire, parallel analysis was applied based on the approach advocated by Hoyle and Duvall (2004). The first step in the construct validation is to determine the Eigenvalue of the system. The Eigenvalue components greater than 1 ($p < 0.05$) were used as the

principal components and were considered to represent the hidden factors underlying the multivariate space that bridged from side to side by the individual items. Parallel analysis was then performed (Fig 3.1) (Raiche & Magis, 2010). Exploratory Factor Analysis (EFA) was then performed using Principal Axis Factoring. Principal Axis Factoring was performed using the oblique rotation method, (Promax). The Varimax was then run to check that the Promax provided a better fit (i.e. an assumption that the different subscales were correlated). All loadings in the pattern matrix not exceeding 0.3 were ignored (Revelle, 2013). Following EFA, Confirmatory Factor Analysis (CFA) was used to confirm the structure explained by EFA. If the Promax that was already run showed an adequate fit and all the loadings were significant then the measurement model was considered constructively valid. Similar to the statistical tests used in Saris and Stronkhorst (1984) and De Grave *et al*., (1998) studies, three fit statistics were used to assess goodness of model adequate fit: Chi-square (χ^2), Goodness of Fit Index (GFI), and the Root Mean Square Error of Approximations (RMSEA). The χ^2 statistic is widely used to assess the fit structural equation models (of which CFA is an example), but it has been shown to be highly biased with sample size, especially for CFA models which are highly compelled (Hooper *et al*., 2008; Stallman & Hurst, 2011) and is included here for reasons of convention only. GFI evaluates the model fit by measuring the fit between an estimated model and the observed covariance matrix (Tabachnick & Fidell, 2013). A GFI greater than 0.9 is considered a good fit (Byrne, 1994). The RMSEA evaluates the model fit by assessing how well an unknown but optimally chosen parameter estimates fit the population covariance matrix (Hooper *et al*., 2008) and an RMSEA value of < 0.06 suggests a good model fit (Browne & Cudeck, 1993).

To ensure that the measurement model in the CFA was not overfit, the data set was split and different sets were used for the EFA and CFA steps. EFA was conducted using the First year students and CFA was conducted on the second and third-year students. The allocation of statistical methods on different years was due to the statistical approach used for the purpose of the construct validity.

It is important to note that in terms of the EFA and CFA, three subscales (skills

development (SD), group process (GP), learning preference (LP)) canvassing students' perceptions of their own preferences and development were considered together 12 items), while the fourth subscale (tutor practice, TP) (four items) was validated independent of these three subscales. This was done because the internal consistency of the TP construct can be attained if separated from the three subscales. The application of the statistical validating testing of the developed instrument is explained in the following two sections.

3.2.3.1. Skills Development (SD), Group Process (GP), Learning Process (LP) Instrument validation

The number of factors underlying the SD-GP-LP (12 items) data was determined using parallel analysis from the Principal Component Analysis (Figure 3.1). The parallel analysis indicated three factors were likely to underlay this data structure.

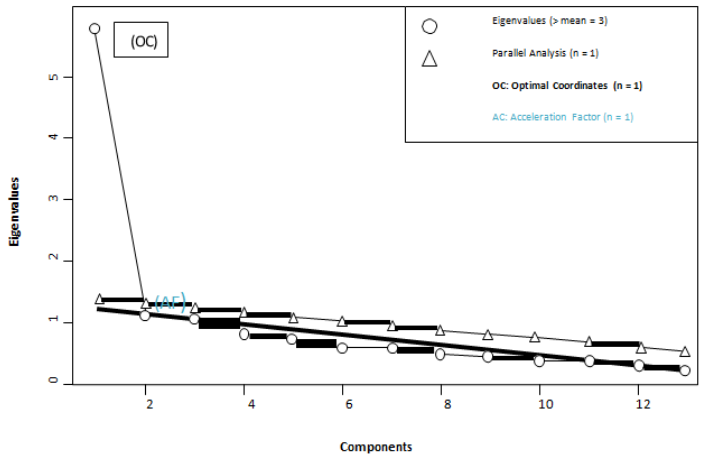


Figure 3.1: Non-graphical solutions to Scree Test - Parallel Analysis (PA)

Non-graphical solutions to Scree Test - Parallel analysis (PA) (Figure 3.1) were based on a principal components analysis of the 12 skills development (SD), group process (GP) and learning preference (LP) items. Eigenvalues not completely below the bold line are considered to represent significant constructs. From the PA results, Principal Axis Factoring (PAF) assuming three factors was performed. Promax (-oblique) rotation was conducted to better align the individual items with the

underlying factors. The loadings and inter-factor correlations are provided in Tables 3.3 and 3.4, respectively. Table 3.3 displays the factor loadings from Principal Axis Factoring (EFC) and Confirmatory Factor Analysis (CFA). Loadings from the Principal Factor Analysis < 0.35 are excluded from the table and Loadings from the CFA are standardised and were significant at the $\alpha = 0.001$ level.

Table 3.3: Skills Development-Group Process-Learning Preference (SD-GP-LP) loadings from the Principal Factor Analysis

	Exploratory Factor Analysis			**Confirmatory Factor Analysis**		
Item	**Factor 1**	**Factor 2**	**Factor 3**	**SD**	**GP**	**LP**
Skills development (SD)						
SD1	0.45			0.83		
SD2	0.99			0.82		
SD3	0.91			0.80		
SD4	0.39			0.66		
SD5	0.68			0.67		
Group process (GP)						
GP6		0.74			0.66	
GP7		0.66			0.67	
GP8		0.36			0.59	
GP9		0.92			0.59	
Learning preference (LP)						
LP10			0.50			0.68
LP11			0.88			0.67
LP12			0.82			0.75

Perusal of the PFA loadings suggests a close alignment of the loadings hypothesized to collect with the individual subscales. Consequently, the measurement model

structure depicted in Figure 3.2 was then run using CFA. The factor loadings and inter-factor correlations resulting from the confirmatory factor analysis are provided in Tables 3.3 and 3.4.

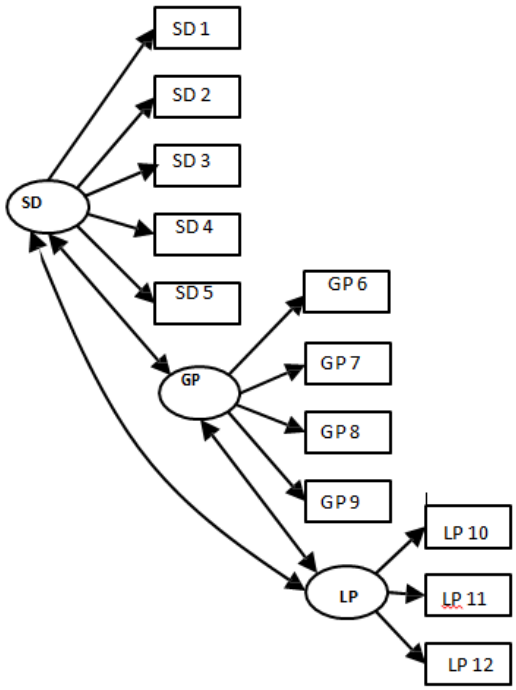


Figure 3.2: SD-GP-LP measurement model loadings structure

Table 3.4 shows the inter-factor correlations from the Principal Axis factoring (EFA) and the CFA (values in bold). The inter-factor correlations from the CFA were all significant at the $p = 0.001$ level of significance.

Table 0.4: Inter-factor correlation resulting from the confirmatory factor analysis

	Factor 1 (SD)	**Factor 2 (GP)**	**Factor 3 (LP)**
Factor 1 (SD)	1.00	**0.89**	**0.84**
Factor 2 (GP)	**0.74**	1.00	**0.78**
Factor 3 (LP)	**0.75**	**0.78**	1.00

The good fit of the measurement instrument to the data (GFI = 0.96, RMSEA = 0.028), high values of measurement model loadings structure (Fig. 3.2) together with their statistical significance (all $p < 0.001$) provide strong evidence for the construct

validity of the Skills Development-Group Process-Learning Preference (SD-GP-LP) instrument.

3.2.3.2. Tutor Practice (TP) instrument validation

As with the SD-GP-LP instrument, Principal Axis Factoring (PAF) followed by Confirmatory Factor Analysis was used to explore and validate the Tutor Practice component of the questionnaire. The factor measurement model structure is given in Figure 3.3, while the item loadings from EFA and the CFA for the Tutor Practice construct are provided in Table 3.5. All loadings from the CFA were significant at the $\alpha = 0.001$ level of significance.

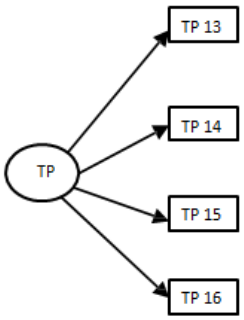


Figure 3.3: Tutor Practice (TP) measurement model loading structure

Table 3.5: The EFA and CFA for the Tutor Practice construct

Item	Loadings (EFA)	Loadings (CFA)
TP13	0.51	0.25
TP14	0.55	0.44
TP15	0.75	0.95
TP16	0.52	0.42

Although there was some reduction of the item-factor loading of TP13 item in the CFA (relative to the EFA), the association between the Tutor Practice factor and TP13 was still highly significant ($p < 0.001$). Figure 3.3 was shown to provide a sufficient fit of data (GFI=0.91, RMSEA=0.048) and together with all loadings being highly significant (Table 3.5), it provides strong evidence of the construct validity of the Tutor Practice instrument. The final version of the questionnaire that was used for further statistical analysis is provided in Appendix 1. It compromises

four subscales.

Students were asked to rate their responses on a 4-point forced choice Likert scale from 1 (Strongly Disagree) to 4 (Strongly Agree). Having a 4-point rating scale that does not allow for a “no opinion” or “undecided” response forces the respondent to make a choice and therefore to express his or her opinion or belief (Krosnick, 1999). The option to measure the level of agreement with any item of the questionnaire in the “neutral“ category (such as in a 5-point scale) was deliberately omitted because it was felt that those choosing this option may have represented one of two distinct groups: those who felt genuinely neutral, and those who didn't know. A 4-point rating scale is a form of “Forced choice” scale.

3.2.4. Participants and data collection

Three cohorts in three consecutive academic years of study (2007-2009) were recruited, resulting in nine groups in total. Recruitment took place in the sixth week of the first semester of the 2007 academic year and then recruited at the same time for the 2008 and 2009 academic years (Table 3.6). Two approaches were used to apply the statistical analysis. The cross-sectional sample was recruited from the first year students in the three cohorts (2007, 2008 and 2009) while the longitudinal sample comprised the first year students of 2007 cohort and followed through the cohorts of 2008 and 2009. The sample total and the demographic characteristics of the cross-sectional and longitudinal samples are displayed in Table 3.6.

Table 3.6: Sample size and attributes of Bond medical students in the cross-sectional and longitudinal study

Year of study	Sample recruited	Participants	Gender		Age		Education level		Home language	
			M	F	16-20	20+	School-leavers	Graduate	English	Non-English
Cohort										
2007 (Y1, Y2, Y3)	240	120	45.83% (*n* = 55)	52.50% (*n* = 63)	55.00% (*n* = 66)	45.00% (*n* = 54)	75.00% (*n* = 90)	25.00% (*n* = 30)	75.83% (*n* = 91)	24.17% (*n* = 29)
2008 (Y1, Y2, Y3)	251	180	44.44% (*n* = 80)	55.56% (*n* = 100)	47.78% (*n* = 86)	52.22% (*n* = 94)	70.00% (*n* = 126)	30.00% (*n* = 54)	76.11% (*n* = 137)	33.89% (*n* = 43)
2009 (Y1, Y2, Y3)	252	159	37.11% (*n* = 59)	62.89% (*n* = 100)	47.17% (*n* = 75)	52.83% (*n* = 84)	76.10% (*n* = 121)	23.90% (*n* = 38)	76.10% (*n* = 121)	23.90% (*n* = 38)
Cross-sectional										
First year (2007-2009)	273	197	38.58% (*n* = 76)	61.42% (*n* = 121)	51.78% (*n* = 102)	48.22% (*n* = 95)	74.62% (*n* = 147)	25.38% (*n* = 50)	78.17% (*n* = 154)	21.83% (*n* = 43)
Second year (2007-2009)	251	142	44.37% (*n* = 63)	54.23% (*n* = 77)	53.52% (*n* = 76)	46.48% (*n* = 66)	70.42% (*n* = 100)	29.58% (*n* = 42)	75.35% (*n* = 107)	24.65% (*n* = 35)
Third year (2007-2009)	219	120	45.83% (*n* = 55)	54.17% (*n* = 65)	40.83% (*n* = 49)	59.17% (*n* = 71)	75.00% (*n* = 90)	25.00% (*n* = 30)	73.33% (*n* = 88)	26.67% (*n* = 32)
Longitudinal										
2007 - Y 1	66	64	35.94% (*n* = 23)	64.06% (*n* = 41)	81.25% (*n* = 52)	18.75% (*n* = 12)	78.13% (*n* = 50)	21.87% (*n* = 14)	68.75% (*n* = 44)	31.25% (*n* = 20)
2008 - Y 2	63	62	38.71% (*n* = 24)	61.29% (*n* = 38)	79.03% (*n* = 49)	20.97% (*n* = 13)	74.20% (*n* = 46)	25.80% (*n* = 16)	74.20% (*n* = 46)	25.80% (*n* = 16)
2009 - Y 3	54	54	37.03% (*n* = 20)	62.96% (*n* = 34)	83.33% (*n* = 45)	16.67% (*n* = 9)	79.63% (*n* = 43)	20.37% (*n* = 11)	70.37% (*n* = 38)	29.63% (*n* = 16)

Longitudinal sample was recruited from the 64 students participated in year 1 in 2007, 62 (Year 2 in 2008) and 54 (Year 3 in 2009) participated in subsequent longitudinal data collection over the years of the study.

Two approaches were applied to this sample: cross-sectional and longitudinal. After ethical approval was obtained from the Bond University Human Research Ethics Committee (Appendix 3) and with permission from the relevant teachers, students were informed of the purpose and the details of the study and asked to consider participating. Students wishing to participate signed the consent forms (Appendix 2) and proceeded to complete the questionnaire while the researcher remained outside the lecture theatre. The completed questionnaires were collected at the end of the same class by the researcher.

3.2.5. Categorisation of variables, descriptive statistics and statistical analysis models

Demographic variables obtained in the first part of the questionnaire were categorised on a nominal scale (i.e. males = 1, females = 2). The same categorisation was followed for the other demographic characteristics. For the second part of the questionnaire, the level of agreement was ranked according to an ordinal scale based on the forced choice scale where it ascends through four values starting with 1 (Strongly Disagree and ending with 4 (Strongly Agree). These numerical values were used only for the purpose of ranking and calculations.

For categorical variables such as cohort, year of study, gender, age, education level and home language, frequencies and percentages were used to describe the data. For continuous variables such as the response rates, the mean and standard error were presented. The choice of statistical model used to analyse the various each outcome was based on the measurement scale of the variable. All continuous variables (representing a large majority of the outcomes) were modelled using the general linear model (Dobson & Barnett, 2008).

All modelling was performed at the bivariate and multivariable level to obtain crude and adjusted effects, respectively. For all multivariable general linear models, estimated marginal (confounder-adjusted) means were generated. It is important to note that there is a design effect in the collection of data. Data collection in later years (Years 2 and 3) represents repeated data items. Normally, post hoc adjustments

(such as robust estimators) or appropriate models (for example, a linear mixed model for continuous outcomes) would be used to analyse these data. Even repeated items of the same student, however, represent longitudinal observations. For reasons of ethics and to maximise sample size (by assuring anonymity of participants), the data in each year were completely de-identified. This de-identification process implies that a particular participant cannot be tracked over years, i.e. there is no participant identification variable that matches the observations belonging to the measurement unit. As a consequence, all observations had to be treated as independent (as in a cross-sectional study with no clustering effect) and only methods suitable for cross-sectional data could be used. The statistical implication of ignoring the clustering of the repeated observations is that the model standard errors may be underestimated. For this reason, interpretations of statistical significance from the questionnaire should be treated with care, as there is an increased chance of a type I error (false positive). A significance level of 0.05 was used for all analyses.

The statistical methods used to answer the research questions and to test the hypotheses were the crude effect differences (for example, differences between the sample means) that were derived from the bivariate model. These were calculated at the beginning of the analysis, as they can be misleading as there are other types of differences that get mixed up with (confound) factors such as the year of difference effect. Multivariable models (adjusted effects), for example, the year of study effect, are adjusted for gender, age, education level and home language. Estimated Marginal Means (EMMS) - the adjusted means - were calculated. The F-test was also performed with some of the statistical methods to test the global hypothesis of group equality. These statistical methods are the standard types used for this type of study due to their ability to best improve generalisability and minimise error (Dobson & Barnett, 2008; Revelle, 2013; Tabachnick & Fidell, 2013). The data were analysed using SPSS (Statistical Package for the Social Sciences, Version 21.0). The SE used in the following data sets reflects the variability of the mean values, and both statistical significance testing (SE, SD) are useful so we can choose either one because they aid in explaining the meaning of the findings.

3.3. Results

The following section provides an explanatory and analytical report of the students' views of questionnaire items and illustrates the comparison between the results of all the first, second and third-year students in three cohorts (cross-sectional). In an attempt to further the study by looking at the year of study effect, students entering medicine in 2007 were followed through into their second (2008) and third (2009) years, allowing for longitudinal examination.

The following section provides an explanatory and analytical report of the cross-sectional (three x Year 1, three x Year 2 and three x Year 3 cohorts) and longitudinal studies (Y1 students from 2007 followed up in 2008 and 2009) of the students' views.

3.3.1. Cross-sectional study

The effect of demographics on the following subscales: skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP) were explored. Table 3.7 illustrates the Mean and Standard Error (SE) of the students' responses towards PBL in terms of their skills development, group process, learning preference and their views toward tutor practice for three year groups (Years 1-3) comprising three cohorts (2007-2009).

In a t-test on this set of data (Table 3.7), Year 1 students rated their group process and learning preference significantly higher than did their Year 2 and Year 3 colleagues. Year 1 students rated their tutor skills significantly higher than their Year 2 peers. None of the differences found between year 2 and 3 were detected significant. Although statistical significant differences were found between Year 1, 2 and 3 students in this cross-sectional study, there were no significant differences for the demographics tested (i.e. gender, age, education level and language background), as depicted in Tables 3.7a-d).

Table 3.7: Mean and Standard Error (SE) of Year 1-3 student perceptions of PBL in the cross-sectional study in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

Subscales and items	Year 1 (*n* = 197)	Year 2 (*n* = 142)	Year 3 (*n* = 120)
	Mean ± SE	Mean ± SE	Mean ± SE
Skills development	2.75 ± 0.05	2.80 ± 0.05	2.82 ± 0.06
1. I developed critical thinking skills through PBL tutorials	2.90 ± 0.05	2.95 ± 0.06	2.99 ± 0.06
2. I developed problem solving skills in PBL	2.87 ± 0.05	2.88 ± 0.06	3.01 ± 0.05
3. I developed the ability to think laterally in solving problems in PBL	2.85 ± 0.05	2.90 ± 0.06	2.84 ± 0.06
4. I have gained skills in making diagnosis in PBL	2.80 ± 0.05	3.02 ± 0.05	3.03 ± 0.06
5. PBL enhanced my communication skills	2.98 ± 0.05	2.93 ± 0.07	2.91 ± 0.06
Group process	3.03 ± 0.04**2,3	2.85 ± 0.04	2.77 ± 0.06
6. PBL tutorials promote teamwork	3.32 ± .04	3.13 ± .06	3.06 ± 0.07
7. The small group setting of PBL encourages the group to share their ideas	3.31 ± 0.05	3.07 ± 0.05	3.09 ± 0.06
8. Everyone in my PBL group contributes significantly to the discussion	2.71 ± 0.06	2.39 ± 0.07	2.43 ± 0.07
9. I like sharing my knowledge with my PBL group	3.17 ± 0.05	3.13 ± 0.04	3.11 ± 0.06
Learning preference	2.69 ± 0.06**2,3	2.41 ± 0.07	2.39 ± 0.08
10. I prefer PBL classes to didactic teaching such as lectures	2.83 ± 0.06	2.56 ± .08	2.52 ± 0.08
11. I learn better in a small group tutorial than in a large group lecture	3.01 ± 0.07	2.89 ± 0.07	2.81 ± 0.09
12. I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.83 ± 0.07	2.61 ± 0.08	2.67 ± 0.08
Tutor practice	2.76 ± 0.06**2	2.55 ± 0.06	2.72 ± 0.07
13. My tutor promotes a relaxed atmosphere in PBL tutorials	3.29 ± 0.05	2.96 ± 0.06	3.18 ± 0.06
14. My tutor asks lots of questions about the problem being solved	2.72 ± 0.05	2.83 ± 0.06	2.88 ± 0.05
15. 15. My tutor uses questions to keep the group on track	3.16 ± 0.05	3.01 ± 0.05	3.04 ± 0.05
16. My tutor is good at resolving conflicts in the group	2.98 ± 0.05	2.72 ± 0.06	2.95 ± 0.06

***2 p < 0.01= Significant difference between Year 1 and Year 2*
***3 p < 0.01= Significant difference between Year 1 and Year 3*

Table 3.7a: Mean and Standard Error (SE) of Year 1-3, male and female student perceptions of PBL in the cross-sectional study in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1 (*n* = 197)		Year 2 (*n* = 142)		Year 3 (*n* = 120)	
		M	**F**	**M**	**F**	**M**	**F**
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Ite	**Skills development**	2.69 ± 0.06	2.81 ± 0.06	2.74 ± 0.08	2.86 ± 0.07	2.77 ± 0.08	2.83 ± 0.08
1	I developed critical thinking skills through PBL tutorials	2.85 ± 0.08	3.00 ± 0.06	2.93 ± 0.10	2.99 ± 0.07	2.96 ± 0.08	2.95 ± 0.09
2	I developed problem solving skills in PBL	2.84 ± 0.07	2.72 ± 0.07	2.85 ± 0.09	2.93 ± 0.07	3.00 ± 0.09	3.02 ± 0.06
3	I developed the ability to think laterally in solving problems in PBL	2.79 ± 0.07	2.82 ± 0.07	2.92 ± 0.09	2.92 ± 0.08	2.76 ± 0.08	2.90 ± 0.07
4	I have gained skills in making diagnosis in PBL	2.67 ± 0.08	2.97 ± 0.06	3.13 ± 0.06	2.94 ± 0.07	2.92 ± 0.09	3.09 ± 0.07
5	PBL enhanced my communication skills	2.93 ± 0.09	3.00 ± 0.07	2.78 ± 0.10	3.04 ± 0.09	2.84 ± 0.09	2.92 ± 0.09
	Group process	3.05 ± 0.06	3.02 ± 0.07	2.83 ± 0.06	2.89 ± 0.05	2.80 ± 0.07	2.75 ± 0.09
6	PBL tutorials promote team work	3.28 ± 0.07	3.42 ± 0.06	3.07 ± 0.09	3.18 ± 0.08	3.12 ± 0.09	3.02 ± 0.09
7	The small group setting of PBL encourages the group to share their ideas	3.30 ± 0.07	3.25 ± 0.07	3.07 ± 0.07	3.11 ± 0.06	3.00 ± 0.09	3.16 ± 0.08
8	Everyone in my PBL group contributes significantly to the discussion	2.69 ± 0.09	2.72 ± 0.08	2.43 ± 0.10	2.38 ± 0.09	2.26 ± 0.10	2.63 ± 0.10
9	I like sharing my knowledge with my PBL group	3.23 ± 0.06	3.24 ± 0.06	3.16 ± 0.05	3.12 ± 0.06	3.08 ± 0.10	3.12 ± 0.06
	Learning preference	2.70 ± 0.09	2.69 ± 0.09	2.34 ± 0.10	2.50 ± 0.09	2.29 ± 0.12	2.46 ± 0.10
10	I prefer PBL classes to didactic teaching such as lectures	2.85 ± 0.09	2.78 ± 0.07	2.65 ± 0.10	2.61 ± 0.09	2.51 ± 0.13	2.51 ± 0.10
11	I learn better in a small group tutorial than in a large group lecture	3.01 ± 0.10	3.03 ± 0.09	2.86 ± 0.11	2.92 ± 0.09	2.60 ± 0.12	2.95 ± 0.10
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.76 ± 0.10	3.06 ± 0.08	2.62 ± 0.11	2.67 ± 0.09	2.62 ± 0.12	2.75 ± 0.10
	Tutor practice	2.69 ± 0.09	2.81 ± 0.07	2.51 ± 0.10	2.60 ± 0.09	2.77 ± 0.10	2.73 ± 0.09
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.25 ± 0.07	3.33 ± 0.05	2.95 ± 0.07	3.00 ± 0.08	3.16 ± 0.10	3.24 ± 0.07
14	My tutor asks lots of questions about the problem being solved	2.67 ± 0.07	2.51 ± 0.06	2.91 ± 0.07	2.79 ± 0.07	2.93 ± 0.08	2.84 ± 0.07
15	My tutor uses questions to keep the group on track	3.10 ± 0.07	3.24 ± 0.05	3.11 ± 0.06	2.99 ± 0.06	2.96 ± 0.08	3.12 ± 0.06
16	My tutor is good at resolving conflicts in the group	2.94 ± 0.06	2.94 ± 0.05	2.77 ± 0.06	2.70 ± 0.08	3.00 ± 0.09	2.96 ± 0.07

Table 3.7b: Mean and Standard Error (SE) of Year 1-3, 16-20 years and 20+ years student perceptions of PBL in the cross- sectional study in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1 (*n* = 197)		Year 2 (*n* = 142)		Year 3 (*n* = 120)	
		16-20	20+	16-20	20+	16-20	20+
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.82 ± 0.05	2.46 ± 0.10	2.80 ± 0.06	2.80 ± 0.09	2.83 ± 0.06	2.78 ± 0.13
1	I developed critical thinking skills through PBL tutorials	2.97 ± 0.05	2.62 ± 0.11	2.99 ± 0.06	2.84 ± 0.13	3.01 ± 0.06	2.91 ± 0.14
2	I developed problem solving skills in PBL	2.95 ± 0.05	2.55 ± 0.12	2.93 ± 0.06	2.74 ± 0.11	3.00 ± 0.06	3.04 ± 0.13
3	I developed the ability to think laterally in solving problems in PBL	2.92 ± 0.05	2.57 ± 0.12	2.90 ± 0.07	2.94 ± 0.10	2.85 ± 0.06	2.79 ± 0.10
4	I have gained skills in making diagnosis in PBL	2.89 ± 0.05	2.44 ± 0.11	3.03 ± 0.06	3.00 ± 0.07	3.03 ± 0.06	3.00 ± 0.13
5	PBL enhanced my communication skills	3.05 ± 0.05	2.71 ± 0.14	2.98 ± 0.07	2.77 ± 0.14	2.92 ± 0.07	2.88 ± 0.15
	Group process	3.07 ± 0.05	2.90 ± 0.10	2.88 ± 0.05	2.78 ± 0.08	2.75 ± 0.06	2.88 ± 0.14
6	PBL tutorials promote team work	3.38 ± 0.05	3.08 ± 0.10	3.17 ± 0.06	3.00 ± 0.12	3.01 ± 0.07	3.26 ± 0.15
7	The small group setting of PBL encourages the group to share their ideas	3.34 ± 0.05	3.15 ± 0.12	3.11 ± 0.05	2.94 ± 0.13	3.09 ± 0.07	3.13 ± 0.13
8	Everyone in my PBL group contributes significantly to the discussion	2.77 ± 0.06	2.50 ± 0.13	2.46 ± 0.07	2.13 ± 0.13	2.45 ± 0.08	2.38 ± 0.17
9	I like sharing my knowledge with my PBL group	3.20 ± 0.05	3.08 ± 0.11	3.15 ± 0.05	3.06 ± 0.09	3.10 ± 0.06	3.13 ± 0.11
	Learning preference	2.75 ± 0.07	2.43 ± 0.12	2.42 ± 0.08	2.40 ± 0.12	2.36 ± 0.09	2.50 ± 0.17
10	I prefer PBL classes to didactic teaching such as lectures	2.89 ± 0.07	2.59 ± 0.13	2.64 ± 0.07	2.52 ± 0.14	2.48 ± 0.09	2.67 ± 0.18
11	I learn better in a small group tutorial than in a large group lecture	3.07 ± 0.07	2.73 ± 0.14	2.93 ± 0.08	2.72 ± 0.13	2.84 ± 0.08	2.70 ± 0.23
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.93 ± 0.07	2.41 ± 0.13	2.64 ± 0.08	2.54 ± 0.15	2.70 ± 0.08	2.57 ± 0.22
	Tutor practice	2.81 ± 0.06	2.54 ± 0.11	2.60 ± 0.07	2.36 ± 0.13	2.77 ± 0.07	2.54 ± 0.18
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.37 ± 0.05	3.00 ± 0.13	3.04 ± 0.07	2.69 ± 0.11	3.15 ± 0.07	3.29 ± 0.11
14	My tutor asks lots of questions about the problem being	2.80 ± 0.06	2.38 ± 0.10	2.89 ± 0.06	2.64 ± 0.10	2.89 ± 0.05	2.84 ± 0.12
15	My tutor uses questions to keep the group on track	3.22 ± 0.05	2.94 ± 0.10	3.01 ± 0.06	3.04 ± 0.09	3.04 ± 0.05	3.00 ± 0.10
16	My tutor is good at resolving conflicts in the group	3.01 ± 0.04	2.82 ± 0.12	2.74 ± 0.07	2.70 ± 0.10	2.94 ± 0.06	3.00 ± 0.12

Table 3.7c: Mean and Standard Error (SE) of Year 1-3, school-leavers and graduate student perceptions of PBL in the cross- sectional study in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1 (*n* = 197)		Year 2 (*n* = 142)		Year 3 (*n* = 120)	
		School-leavers	Graduate	School-leavers	Graduate	School-leavers	Graduate
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.73 ± 0.05	2.82 ± 0.11	2.78 ± 0.06	2.85 ± 0.09	2.88 ± 0.06	2.60 ± 0.13
1	I developed critical thin king skills through PBL tutorials	2.87 ± 0.05	2.96 ± 0.09	2.94 ± 0.07	2.98 ± 0.10	3.06 ± 0.06	2.75 ± 0.12
2	I developed problem solving skills in PBL	2.83 ± 0.06	2.98 ± 0.09	2.86 ± 0.06	2.93 ± 0.12	3.03 ± 0.06	2.92 ± 0.11
3	I developed the ability to think laterally in solving problems in PBL	2.82 ± 0.05	2.96 ± 0.10	2.85 ± 0.07	3.02 ± 0.11	2.87 ± 0.06	2.72 ± 0.13
4	I have gained skills in making diagnosis in PBL	2.78 ± 0.06	2.87 ± 0.10	3.01 ± 0.06	3.05 ± 0.08	3.08 ± 0.06	2.82 ± 0.14
5	PBL enhanced my communication skills	2.97 ± 0.06	3.00 ± 0.11	2.93 ± 0.07	2.93 ± 0.12	2.99 ± 0.06	2.65 ± 0.16
	Group Process	3.05 ± 0.05	2.98 ± 0.10	2.85 ± 0.06	2.85 ± 0.07	2.80 ± 0.07	2.66 ± 0.13
6	PBL tutorials promote team work	3.33 ± 0.05	3.29 ± 0.08	3.13 ± 0.06	3.12 ± 0.12	3.08 ± 0.07	3.00 ± 0.15
7	The small group setting of PBL encourages the group to share their ideas	3.30 ± 0.05	3.33 ± 0.09	3.06 ± 0.06	3.10 ± 0.09	3.14 ± 0.07	2.92 ± 0.14
8	Everyone in my PBL group contributes significantly to the discussion	2.73 ± 0.06	2.67 ± 0.10	2.43 ± 0.08	2.27 ± 0.10	2.42 ± 0.08	2.48 ± 0.15
9	I like sharing my knowledge with my PBL group	3.20 ± 0.05	3.11 ± 0.10	3.10 ± 0.05	3.20 ± 0.07	3.17 ± 0.05	2.88 ± 0.16
	Learning Preference	2.70 ± 0.07	2.66 ± 0.12	2.43 ± 0.08	2.36 ± 0.12	2.38 ± 0.09	2.44 ± 0.15
10	I prefer PBL classes to didactic teaching such as lectures	2.83 ± 0.07	2.82 ± 0.11	2.61 ± 0.07	2.58 ± 0.13	2.51 ± 0.09	2.56 ± 0.14
11	I learn better in a small group tutorial than in a large group lecture	3.04 ± 0.08	2.89 ± 0.12	2.87 ± 0.09	2.89 ± 0.11	2.79 ± 0.09	2.87 ± 0.17
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.84 ± 0.07	2.78 ± 0.12	2.57 ± 0.08	2.70 ± 0.13	2.69 ± 0.09	2.61 ± 0.14
	Tutor practice	2.73 ± 0.07	2.84 ± 0.10	2.59 ± 0.07	2.46 ± 0.12	2.72 ± 0.07	2.71 ± 0.15
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.31 ± 0.05	3.24 ± 0.09	2.97 ± 0.07	2.93 ± 0.11	3.19 ± 0.07	3.15 ± 0.13
14	My tutor asks lots of questions about the problem being solved	2.71 ± 0.06	2.76 ± 0.10	2.84 ± 0.06	2.83 ± 0.10	2.92 ± 0.05	2.74 ± 0.12
15	My tutor uses questions to keep the group on track	3.17 ± 0.05	3.15 ± 0.08	2.97 ± 0.06	3.11 ± 0.08	3.02 ± 0.05	3.09 ± 0.10
16	My tutor is good at resolving conflicts in the group	2.98 ± 0.05	2.98 ± 0.09	2.74 ± 0.07	2.67 ± 0.09	2.90 ± 0.06	3.14 ± 0.13

Table 3.7d: Mean and Standard Error (SE) of Year 1-3, English and non-English student perceptions of PBL in the cross-sectional study in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1 (*n* = 197)		Year 2 (*n* = 142)		Year 3 (*n* = 120)	
		English	Non-English	English	Non-English	English	Non-English
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.76 ± 0.05	2.73 ± 0.09	2.80 ± 0.06	2.78 ± 0.12	2.81 ± 0.06	2.84 ± 0.11
1	I developed critical thinking skills through PBL tutorials	2.89 ± 0.05	2.90 ± 0.09	2.94 ± 0.06	2.97 ± 0.10	3.04 ± 0.06	2.87 ± 0.10
2	I developed problem solving skills in PBL	2.88 ± 0.06	2.83 ± 0.10	2.88 ± 0.06	2.88 ± 0.13	3.01 ± 0.06	3.00 ± 0.10
3	I developed the ability to think laterally in solving problems in PBL	2.87 ± 0.05	2.81 ± 0.10	2.91 ± 0.07	2.85 ± 0.12	2.77 ± 0.06	3.00 ± 0.10
4	I have gained skills in making diagnosis in PBL	2.85 ± 0.06	2.64 ± 0.11	3.03 ± 0.05	3.00 ± 0.13	3.05 ± 0.06	2.96 ± 0.11
5	PBL enhanced my communication skills	2.97 ± 0.06	3.02 ± 0.12	2.89 ± 0.07	3.03 ± 0.13	2.92 ± 0.06	2.91 ± 0.14
	Group process	3.02 ± 0.05	3.10 ± 0.05	2.84 ± 0.05	2.89 ± 0.07	2.78 ± 0.07	2.77 ± 0.11
6	PBL tutorials promote team work	3.31 ± 0.05	3.35 ± 0.09	3.11 ± 0.07	3.18 ± 0.11	3.09 ± 0.07	3.00 ± 0.14
7	The small group setting of PBL encourages the group to share their ideas	3.31 ± 0.05	3.29 ± 0.10	3.12 ± 0.06	2.94 ± 0.08	3.12 ± 0.07	3.03 ± 0.13
8	Everyone in my PBL group contributes significantly to the discussion	2.70 ± 0.06	2.78 ± 0.12	2.34 ± 0.08	2.51 ± 0.11	2.40 ± 0.08	2.54 ± 0.15
9	I like sharing my knowledge with my PBL group	3.13 ± 0.05	3.33 ± 0.08	3.17 ± 0.05	3.03 ± 0.09	3.07 ± 0.06	3.20 ± 0.12
	Learning preference	2.64 ± 0.07	2.87 ± 0.11	2.47 ± 0.08	2.24 ± 0.08	2.44 ± 0.09	2.24 ± 0.17
10	I prefer PBL classes to didactic teaching such as lectures	2.79 ± 0.07	2.98 ± 0.12	2.67 ± 0.07	2.37 ± 0.13	2.53 ± 0.09	2.46 ± 0.15
11	I learn better in a small group tutorial than in a large group lecture	2.93 ± 0.07	3.27 ± 0.11	2.92 ± 0.08	2.78 ± 0.15	2.83 ± 0.09	2.75 ± 0.16
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.82 ± 0.07	2.85 ± 0.14	2.65 ± 0.08	2.50 ± 0.14	2.68 ± 0.08	2.65 ± 0.17
	Tutor practice	2.76 ± 0.07	2.74 ± 0.11	2.57 ± 0.07	2.51 ± 0.15	2.68 ± 0.07	2.82 ± 0.13
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.32 ± 0.05	3.19 ± 0.10	2.99 ± 0.06	2.84 ± 0.15	3.14 ± 0.07	3.28 ± 0.08
14	My tutor asks lots of questions about the problem being solved	2.74 ± 0.06	2.64 ± 0.10	2.84 ± 0.06	2.81 ± 0.12	2.89 ± 0.05	2.85 ± 0.12
15	My tutor uses questions to keep the group on track	3.19 ± 0.05	3.08 ± 0.11	3.00 ± 0.06	3.03 ± 0.10	2.96 ± 0.05	3.24 ± 0.09
16	My tutor is good at resolving conflicts in the group	3.01 ± 0.05	2.87 ± 0.07	2.72 ± 0.06	2.71 ± 0.14	2.84 ± 0.06	3.26 ± 0.11

Crude effect differences are calculated from the bivariate model analysis. Crude effect differences are attained when calculating the average of two raw samples without adjusting any effects, i.e. when collecting the sample and attaining the average depending on two predictor variables without any adjustment for the other factors (Table 3.8). Table 3.8 provides the crude effect results for the bivariate analysis of each outcome (SD, GP, LP and TP) against each predictor (gender, age, education level, language, year of study and cohort). Results for the crude effects (Table 3.8) indicate that age has a significant effect ($p < 0.05$) for all constructs except for Skills Development, although this did appear to be a trend for this subscale. In all cases, the older group (20+ years old) scored lower than the younger age group (16-20 years old). Year of study also had an effect on the Group Process, Learning Preference and Tutor Practice constructs, with second and third years scoring lower than first years for Group Process and Learning Preference and second years (but not third years) scoring significantly lower for Tutor Practice (all $p < 0.05$, Table 3.8). It should be noted that although the 2009 cohort rating appeared to be significantly lower than the 2007 cohort ($p < 0.05$) for the Tutor Practice construct, the test of the global cohort effect was not significant ($F = 2.81$, $p = 0.062$). In Table 3.8, crude effect sizes are represented by the β from the bivariate General Linear Models. For multi-category predictors, an F-test was performed.

Table 3.8: Crude effects for the bivariate analysis of demographics on the SD, GP, LP and TP subscales

Effect (Reference)	Skills Development (SD)	Group Process (GP)	Learning Preference (LP)	Tutor Practice (TP)
Gender (Male)	0.390	0.127	0.268	0.061
Age (20+ years old)	-0.402	-0.337**	-0.350*	-0.247*
Education (Graduate)	-0.305	-0.101	0.011	-0.156
Language (Non-English)	-0.032	-0.028	-0.073	-0.024
Year of study (Year 1)	***F=0.45***	***F=6.25****	***F=4.23****	***F=4.11****
Year 2	0.053	-0.404**	-0.427*	-0.348*
Year 3	0.259	-0.400**	-0.486*	-0.105
Cohort (2007)	***F=0.05***	***F=2.11***	***F=0.03***	***F=2.81***
2008	0.082	-0.241	-0.049	0.196
2009	0.081	-0.003	-0.020	0.322*

*** p < 0.01, * p < 0.05*

In Table 3.9, the adjusted effects were calculated from the multivariable model analysis (i.e. when adjusting for one factor effect and removing all the other effects out leaving only the factor to be tested). The Estimated Marginal Means (EMMs) (adjusted means) are calculated depending on the values in the adjusted effect table (Table 3.9) and are used to find out the Estimated Marginal Means (Table 3.10). An F-test was used to test the global hypothesis of group equality (Tables 3.8 and 3.9).

The results for the multivariable models showed mixed results (Table 3.9). First, the model for the Skills Development construct is not statistically significant (p = 0.278), so although the age effect appears to be significant for this model, the lack of model significance (p = 0.278) implies that that a significant age effect cannot be made. The multivariable models for Group Process (GP) (p = 0.002), Learning Preference (LP) (p = 0.048) and Tutor Practice (TP) (p = 0.011) were all significant (all $p < 0.05$). The age effect was significant across three of the four constructs or subscales and in all cases, the older groups scored significantly lower than the younger group. The year of study also had an effect for GP ($F = 4.298$, $p < 0.05$), with both the second and third-year students yielding lower scores for GP relative to First year students. The individual levels of year of study for both Learning Preference and Tutor Practice also suggest differences; however, the global F-tests for the year of study effect for both of these models was not statistically significant at the 0.05 level, therefore conclusions of difference cannot be drawn. The same can be said for the cohort effect for the Tutor Practice model. Even though the 2009 cohort appears to be statistically different from the 2007 cohort, the non-significant global test of the cohort effect implies that a difference cannot be concluded. The adjusted effect table (Table 3.9) shows the effects resulting from the multivariable general linear model where all effects are mutually adjusted. It also provided the F-tests for the multi- category predictors (Year of study, Cohort) and the overall model.

Table 3.9: Adjusted effects resulting from the multivariable general linear model

Effect (Reference)	Skills Development (SD)	Group Process (GP)	Learning Preference (LP)	Tutor Practice (TP)
Gender (Male)	0.425	0.099	0.266	-0.040
Age (20+ years old)	-0.465*	-0.350**	-0.378*	-0.287*
Education (Graduate)	-0.206	-0.026	0.069	-0.118
Language (Non-English)	-0.121	-0.06	-0.092	-0.065
Year of study (Year 1)	**F=0.87**	**F=4.298***	**F=3.02**	**F=2.94**
Year 2	0.189	-0.335*	-0.367	-0.291*
Year 3	0.366	-0.332*	-0.412*	-0.103
Cohort (2007)	**F=0.08**	**F=1.26**	**F=0.01**	**F=2.14**
2008	0.000	0.144	-0.015	0.210
2009	-0.093	0.149	-0.016	0.272*
Overall model	**F=1.25 *p*=0.278**	**F=3.11 *p*=0.002**	**F=1.987 *p*=0.047**	**F=2.524 *p*=0.011**

The reference factor (e.g. male) in these tables (3.8, 3.9) is the factor that forms the referent of the statistical calculation. If the referent in Tables 3.8 or 3.9 is displayed with a negative sign (-) it indicates that the reference factor has a lower value than the other factor and if it was displayed without a sign, it indicates that it will have a higher value than the other factor. The resulting values of the adjusted differences (Table 3.9) between the Estimated Marginal Means are illustrated in Table 3.10.

A comparison of the crude (Table 3.8) and adjusted (Table 3.9) effects yields interesting differences. The crude effects suggest that there are year of study differences for both Learning Preference and Tutor Practice. When adjusted for the other demographics in the multivariable model, however, these effects were no longer significant. This suggests that some of the difference between year groups is based on their composition (for example, age and gender) rather than year of study differences.

The following table (Table 3.10) provides the estimated marginal means (EMMs) derived from the multivariable models of adjusted effects (table 3.9). The difference between each of the values of the predictor factor or demographics (i.e. gender, age, education level and home language) found in table 3.10, can be derived from table 3.9. Examination of the means reiterates that the age effect was significant across the board. Again, care should be taken when interpreting the difference for the Skills Development subscale, as the overall model could not be shown to be significant

(Table 3.9). Estimated Marginal Means (EMMs) from the multivariable models provided here where at least two groups differ, groups sharing the same letter (a or b) represent a homogenous set so a and b are significantly different set.

Table 3.10: Estimated Marginal Means (EMMs) derived from the multivariable models of the adjusted effects in Table 3.9

Factor	Skills Development (SD)	Group Process (GP)	Learning Preference (LP)	Tutor Practice (TP)
Gender				
Male	11.81	6.80	5.90	6.03
Female	11.38	6.10	5.63	6.08
Age group				
16-20 years old	11.25[a]	6.93[a]	5.95[a]	6.20[a]
20+ years old	10.79[b]	6.58[b]	5.57[b]	5.92[b]
Education level				
School-leavers	11.12	6.76	5.73	6.11
Graduate	10.92	6.74	5.80	5.99
Language				
English	11.08	6.78	5.81	6.09
Non-English	10.96	6.72	5.72	6.02
Year of study				
Year 1	10.84	6.79[a]	6.02	6.18[a]
Year 2	11.03	6.64[b]	5.66	5.89[b]
Year 3	11.20	6.64	5.61	6.08[ab]

a or b represent a homogenous set so a and b are significantly different set.

The estimated marginal means (alone), as shown in Table 3.10, also suggest that for both Group Process and Tutor Practice, the year of study had a significant effect and that there was a significant difference between Year 1 (GP: 6.97 and 6.18) and Year 2 (TP: 6.64 and 5.89) students (but interestingly not between Year 1 and Year 3 students or Year 2 and Year3 students). Again care should be taken for the Tutor Practice subscale, as the global test of the year of study effect was not significant at the 0.05 level (Table 3.9).

3.3.2. Summary and interpretation: Cross-sectional study

The age effect was significant across three of the four subscales: Group Process, Learning Preference and Tutor Practice, with older students (20+ years) scoring significantly lower than younger students (16-20 years). This suggests that that older students are probably less engaged in their PBL group discussion and learning-oriented activities. Moreover, based on their perception, they seemed to prefer the

conventional type of learning and the traditional role of the teacher or facilitator as a knowledge source rather than knowledge inquirer. Year of study also showed an effect for Group Process (F=4.298, $p < 0.05$), with both second and third-year students yielding lower scores than First year students, suggesting that Year 1 students are more interactive and engaged in the group discussions and contribute more positively to their group activities. Estimated Marginal Means also suggest that for both group process (GP) and tutor practice (TP) that the year of study had a significant effect and that there was a significant difference between Year 1 and Year 2 students (but again not between Year 1 and Year 3 students). The proposition here might be that Year 2 students have become used to the habitual activities of PBL tutorials and be less devoted than the First year students. The difference (*albeit* not significant) between Years 1 and 3 (Year 1 higher) suggests that the progress of the students through their years of studies, as they gain knowledge and are exposed to a variety of cases and attending to different facilitation styles, might have led the third-year students to fail to maintain their eagerness toward the PBL process. Care should be taken with the Tutor Practice subscale, as the global test of the year of study effect was not significant, where 0.05 is the level of significance (Table 3.10).

3.3.3. Longitudinal study

In an attempt to further explore the year of study effect, students entering the medical program in 2007 were followed through into their second (2008) and third year (2009) of study. Table 3.11 shows the aggregated students' perceptions while Tables 3.11a, 3.11b, 3.11c and 3.11d display the students' perception (based on their demographics) toward each of the four subscales of the questionnaire. It should be noted, however, that as the questionnaire was anonymous, individuals could not be tracked over time. The analytical implication is that while technically these students represent a cohort, the appropriate analytical methods for cohort analysis (i.e. linear mixed model) could not be employed as a within-subject effect must be treated as a between-subject effect. In terms of interpretation of the results, care should be taken, especially where a difference is identified, as the group standard errors are likely to be underestimated, leading to possible type I errors. In this part of the study, none of

the differences detected between the different demographic groups i.e. gender, age, education level and language background, was statistically significant.

Table 3.11: Mean and Standard Error (SE) of Year 1(2007), Year 2 (2008), Year 3 (2009) student perceptions of PBL in longitudinal study of a single cohort as they progress in their studies in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

Subscales and items	Year 1/2007 (*n* = 64)	Year 2/2008 (*n* = 63)	Year 3/2009 (*n* = 54)
	Mean ± SE	Mean ± SE	Mean ± SE
Skills development	**2.74 ± 0.63**	**2.80 ± 0.56**	**2.79 ± 0.58**
1. I developed critical thinking skills through PBL tutorials	2.95 ± 0.08	2.97 ± 0.08	2.90 ± 0.07
2. I developed problem-solving skills in PBL	2.71 ± 0.09	2.90 ± 0.08	3.00 ± 0.07
3. I developed the ability to think laterally in solving problems in PBL	2.83 ± 0.09	2.90 ± 0.08	2.85 ± 0.07
4. I have gained skills in making diagnosis in PBL	2.82 ± 0.09	2.95 ± 0.07	3.00 ± 0.06
5. PBL enhanced my communication skills	2.92 ± 0.10	2.82 ± 0.09	2.91 ± 0.09
Group process	**3.01 ± 0.66**	**2.85 ± 0.48**	**2.69 ± 0.73**
6. PBL tutorials promote team work	3.41± 0.07	3.14 ± 0.08	3.00 ± 0.10
7. The small group setting of PBL encourages the group to share their ideas	3.28 ± 0.09	3.02 ± 0.06	3.08 ± 0.08
8. Everyone in my PBL group contributes significantly to the discussion	2.60 ± 0.10	2.25 ± 0.09	2.39 ± 0.11
9. I like sharing my knowledge with my PBL group	3.23 ± 0.08	3.11 ± 0.06	3.08 ± 0.06
Learning preference	**2.61 ± 0.91**	**2.51 ± 0.75**	**2.32 ± 0.85**
10. I prefer PBL classes to didactic teaching such as lectures	2.79 ± 0.09	2.70 ± 0.09	2.44 ± 0.09
11. I learn better in a small group tutorial than in a large group lecture	2.95 ± 0.11	2.95 ± 0.10	2.80 ± 0.11
12. I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.91 ± 0.12	2.65 ± 0.09	2.60 ± 0.11
Tutor practice	**2.66 ± 0.77**	**2.55 ± 0.79**	**2.63 ± 0.76**
13. My tutor promotes a relaxed atmosphere in PBL tutorials	3.30 ± 0.08	2.95 ± 0.08	3.11 ± 0.07
14. My tutor asks lots of questions about the problem being solved	2.58 ± 0.08	2.89 ± 0.08	2.81 ± 0.07
15. My tutor uses questions to keep the group on track	3.20 ± 0.06	2.98 ± 0.06	3.10 ± 0.07
16. My tutor is good at resolving conflicts in the group	2.94 ± 0.07	2.74 ± 0.08	2.84 ± 0.07

Table 3.11a: Mean and Standard Error (SE) of Year 1(2007), Year 2 (2008), Year 3 (2009) male and female student perceptions of PBL in longitudinal study of a single cohort as they progress in their studies in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1/2007		Year 2/2008		Year 3/2009	
		M	F	M	F	M	F
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.67 ± 0.10	2.79 ± 0.06	2.73 ± 0.10	2.79 ± 0.10	2.80 ± 0.08	2.78 ± 0.12
1	I developed critical thinking skills through PBL tutorials	2.79 ± 0.17	3.00 ± 0.11	2.83 ± 0.13	3.03 ± 0.11	2.80 ± 0.14	2.97 ± 0.11
2	I developed problem solving skills in PBL	3.39 ± 0.10	3.42 ± 0.10	2.79 ± 0.10	2.97 ± 0.11	3.10 ± 0.12	2.93 ± 0.14
3	I developed the ability to think laterally in solving problems in PBL	3.33 ± 0.12	3.25 ± 0.12	2.79 ± 0.15	2.97 ± 0.10	3.10 ± 0.14	3.06 ± 0.11
4	I have gained skills in making diagnosis in PBL	2.42 ± 0.13	2.72 ± 0.13	3.05 ± 0.08	2.88 ± 0.10	2.21 ± 0.18	2.50 ± 0.13
5	PBL enhanced my communication skills	3.22 ± 0.09	3.24 ± 0.11	2.71 ± 0.14	2.86 ± 0.12	3.15 ± 0.13	3.03 ± 0.05
	Group process	3.02 ± 0.10	3.01 ± 0.07	2.82 ± 0.11	2.86 ± 0.08	2.86 ± 0.10	2.59 ± 0.14
6	PBL tutorials promote team work	2.88 ± 0.11	3.00 ± 0.11	3.04 ± 0.11	3.18 ± 0.12	2.90 ± 0.07	2.91 ± 0.11
7	The small group setting of PBL encourages the group to share their ideas	2.70 ± 0.13	2.72 ± 0.13	2.96 ± 0.04	3.05 ± 0.09	3.05 ± 0.09	2.97 ± 0.10
8	Everyone in my PBL group contributes significantly to the discussion	2.83 ± 0.12	2.82 ± 0.12	2.46 ± 0.17	2.16 ± 0.12	2.75 ± 0.12	2.91 ± 0.09
9	I like sharing my knowledge with my PBL group	2.57 ± 0.12	2.97 ± 0.11	3.09 ± 0.06	3.14 ± 0.09	2.94 ± 0.05	3.03 ± 0.09
	Learning preference	2.61 ± 0.16	2.61 ± 0.09	2.32 ± 0.16	2.66 ± 0.12	2.22 ± 0.18	2.38 ± 0.15
10	I prefer PBL classes to didactic teaching such as lectures	2.79 ± 0.15	2.78 ± 0.12	2.76 ± 0.16	2.71 ± 0.12	2.17 ± 0.14	2.59 ± 0.11
11	I learn better in a small group tutorial than in a large group lecture	2.83 ± 0.18	3.03 ± 0.15	2.71 ± 0.17	3.05 ± 0.12	2.67 ± 0.17	2.87 ± 0.14
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.67 ± 0.20	3.06 ± 0.15	2.48 ± 0.15	2.82 ± 0.12	2.56 ± 0.18	2.63 ± 0.15
	Tutor practice	2.71 ± 0.15	2.64 ± 0.07	2.48 ± 0.19	2.60 ± 0.13	2.76 ± 0.17	2.55 ± 0.13
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.25 ± 0.15	3.33 ± 0.08	2.91 ± 0.12	2.97 ± 0.11	3.10 ± 0.12	3.12 ± 0.09
14	My tutor asks lots of questions about the problem being solved	2.70 ± 0.10	2.51 ± 0.11	2.90 ± 0.13	2.89 ± 0.10	2.83 ± 0.09	2.79 ± 0.10
15	My tutor uses questions to keep the group on track	3.14 ± 0.10	3.24 ± 0.08	3.10 ± 0.06	2.91 ± 0.09	3.06 ± 0.09	3.13 ± 0.10
16	My tutor is good at resolving conflicts in the group	2.95 ± 0.12	2.94 ± 0.09	2.82 ± 0.08	2.70 ± 0.11	2.94 ± 0.12	2.76 ± 0.09

Table 3.11b: Mean and Standard Error (SE) of Year 1(2007), Year 2 (2008), Year 3 (2009) 16-20 and 20+ student perceptions of PBL in longitudinal study of a single cohort as they progress in their studies in terms of their skills development (SD), group process (GP)

		Year 1		Year 2		Year 3	
		16-20 yrs.	20 + yrs.	16-20 yrs.	20 + yrs.	16-20 yrs.	20 + yrs.
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.80 ± 0.09	2.47 ± 0.19	2.78 ± 0.08	2.85 ± 0.14	2.76 ± 0.09	2.69 ± 0.20
1	I developed critical thinking skills through PBL tutorials	3.02 ± 0.08	2.64 ± 0.20	2.96 ± 0.09	3.00 ± 0.17	2.84 ± 0.09	3.22 ± 0.22
2	I developed problem solving skills in PBL	2.75 ± 0.10	2.55 ± 0.21	2.94 ± 0.09	2.80 ± 0.17	2.93 ± 0.10	3.38 ± 0.25
3	I developed the ability to think laterally in solving problems in PBL	2.88 ± 0.10	2.55 ± 0.21	2.85 ± 0.10	3.07 ± 0.12	3.07 ± 0.09	3.13 ± 0.28
4	I have gained skills in making diagnosis in PBL	2.89 ± 0.09	2.44 ± 0.22	2.93 ± 0.09	3.00 ± 0.00	2.40 ± 0.12	2.33 ± 0.29
5	PBL enhanced my communication skills	2.98 ± 0.10	2.64 ± 0.28	2.83 ± 0.10	2.80 ± 0.20	3.07 ± 0.07	3.13 ± 0.12
	Group process	3.08 ± 0.09	2.68 ± 0.23	2.86 ± 0.08	2.80 ± 0.07	2.68 ± 0.10	2.72 ± 0.34
6	PBL tutorials promote team work	3.47 ± 0.08	3.10 ± 0.17	3.14 ± 0.10	3.13 ± 0.17	2.93 ± 0.07	2.78 ± 0.28
7	The small group setting of PBL encourages the group to share their ideas	3.34 ± 0.09	3.00 ± 0.27	3.02 ± 0.08	3.00 ± 0.10	2.98 ± 0.08	3.11 ± 0.20
8	Everyone in my PBL group contributes significantly to the discussion	2.67 ± 0.10	2.27 ± 0.27	2.35 ± 0.11	1.93 ± 0.15	2.81 ± 0.08	3.00 ± 0.17
9	I like sharing my knowledge with my PBL group	3.29 ± 0.08	2.90 ± 0.22	3.11 ± 0.07	3.13 ± 0.09	3.00 ± 0.07	3.00 ± 0.18
	Learning preference	2.65 ± 0.13	2.39 ± 0.23	2.48 ± 0.11	2.62 ± 0.17	2.30 ± 0.13	2.41 ± 0.30
10	I prefer PBL classes to didactic teaching such as lectures	2.80 ± 0.10	2.73 ± 0.19	2.67 ± 0.10	2.80 ± 0.20	2.39 ± 0.09	2.67 ± 0.29
11	I learn better in a small group tutorial than in a large group lecture	3.06 ± 0.12	2.45 ± 0.25	2.98 ± 0.12	2.86 ± 0.17	2.80 ± 0.11	2.75 ± 0.35
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	3.00 ± 0.13	2.44 ± 0.31	2.63 ± 0.11	2.77 ± 0.15	2.65 ± 0.12	2.38 ± 0.35
	Tutor practice	2.74 ± 0.10	2.32 ± 0.24	2.60 ± 0.11	2.37 ± 0.19	2.66 ± 0.11	2.47 ± 0.33
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.34 ± 0.09	3.24 ± 0.13	3.09 ± 0.11	2.79 ± 0.13	3.18 ± 0.11	3.06 ± 0.10
14	My tutor asks lots of questions about the problem being solved	2.67 ± 0.10	2.42 ± 0.12	2.90 ± 0.11	2.89 ± 0.12	2.67 ± 0.10	2.90 ± 0.09
15	My tutor uses questions to keep the group on track	3.26 ± 0.08	3.10 ± 0.09	3.00 ± 0.06	2.96 ± 0.11	3.16 ± 0.11	3.07 ± 0.09
16	My tutor is good at resolving conflicts in the group	2.97 ± 0.10	2.88 ± 0.10	2.70 ± 0.10	2.78 ± 0.11	2.78 ± 0.09	2.88 ± 0.11

Table 3.11c: Mean and Standard Error (SE) of Year 1(2007), Year 2 (2008), Year 3 (2009) school-leavers and graduate student perceptions of PBL in longitudinal study of a single cohort as they progress in their studies in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1/2007		Year 2/2008		Year 3/2009	
		School-leavers	Graduate	School-leavers	Graduate	School-leavers	Graduate
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.77 ± 0.08	2.62 ± 0.04	2.74 ± 0.08	2.95 ± 0.15	2.80 ± 0.10	2.75 ± 0.08
1	I developed critical thinking skills through PBL tutorials	3.00 ± 0.08	2.75 ± 0.25	2.98 ± 0.10	2.94 ± 0.16	2.90 ± 0.09	2.91 ± 0.09
2	I developed problem solving skills in PBL	2.72 ± 0.10	2.67 ± 0.26	2.96 ± 0.09	2.76 ± 0.14	3.00 ± 0.09	3.00 ± 0.00
3	I developed the ability to think laterally in solving problems in PBL	2.86 ± 0.09	2.67 ± 0.26	2.87 ± 0.10	3.00 ± 0.15	2.86 ± 0.09	2.80 ± 0.13
4	I have gained skills in making diagnosis in PBL	2.83 ± 0.09	2.80 ± 0.27	2.93 ± 0.09	3.00 ± 0.09	3.00 ± 0.08	3.00 ± 0.00
5	PBL enhanced my communication skills	2.98 ± 0.10	2.67 ± 0.28	2.83 ± 0.10	2.80 ± 0.16	2.93 ± 0.10	2.82 ± 0.18
	Group process	3.07 ± 0.09	2.75 ± 0.15	2.83 ± 0.08	2.88 ± 0.09	2.66 ± 0.12	2.80 ± 0.11
6	PBL tutorials promote team work	3.51 ± 0.08	3.00 ± 0.17	3.11 ± 0.10	3.24 ± 0.16	3.00 ± 0.12	3.00 ± 0.13
7	The small group setting of PBL encourages the group to share their ideas	3.37 ± 0.09	2.92 ± 0.26	3.04 ± 0.08	2.94 ± 0.10	3.10 ± 0.10	3.00 ± 0.13
8	Everyone in my PBL group contributes significantly to the discussion	2.67 ± 0.10	2.33 ± 0.28	2.22 ± 0.11	2.35 ± 0.19	2.41 ± 0.12	2.30 ± 0.20
9	I like sharing my knowledge with my PBL group	3.28 ± 0.08	3.00 ± 0.22	3.09 ± 0.08	3.18 ± 0.10	3.08 ± 0.07	3.09 ± 0.09
	Learning preference	2.65 ± 0.12	2.44 ± 0.07	2.54 ± 0.11	2.41 ± 0.20	2.33 ± 0.14	2.30 ± 0.19
10	I prefer PBL classes to didactic teaching such as lectures	2.84 ± 0.10	2.58 ± 0.26	2.69 ± 0.11	2.71 ± 0.20	2.48 ± 0.11	2.30 ± 0.15
11	I learn better in a small group tutorial than in a large group lecture	3.06 ± 0.12	2.50 ± 0.31	2.93 ± 0.12	3.00 ± 0.18	2.77 ± 0.12	2.90 ± 0.22
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.95 ± 0.13	2.70 ± 0.31	2.59 ± 0.11	2.86 ± 0.16	2.66 ± 0.13	2.40 ± 0.21
	Tutor practice	2.69 ± 0.10	2.54 ± 0.10	2.57 ± 0.11	2.50 ± 0.22	2.60 ± 0.12	2.73 ± 0.24
13	My tutor promotes a relaxed atmosphere in PBL tutorials	1.00 ± 0.08	3.08 ± 0.65	2.89 ± 0.11	3.13 ± 0.08	3.07 ± 0.09	3.27 ± 0.14
14	My tutor asks lots of questions about the problem being solved	3.35 ± 0.09	2.56 ± 0.62	2.88 ± 0.10	2.93 ± 0.11	2.84 ± 0.08	2.70 ± 0.15
15	My tutor uses questions to keep the group on track	2.59 ± 0.07	3.30 ± 0.50	3.00 ± 0.08	2.93 ± 0.06	3.08 ± 0.08	3.20 ± 0.13
16	My tutor is good at resolving conflicts in the group	3.18 ± 0.08	2.90 ± 0.59	2.69 ± 0.09	2.86 ± 0.13	2.77 ± 0.07	3.13 ± 0.19

Table 3.11d: Mean and Standard Error (SE) of Year 1(2007), Year 2 (2008), Year 3 (2009) English and non-English student perceptions of PBL in longitudinal study of a single cohort as they progress in their studies in terms of their skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)

		Year 1/2007		Year 2/2008		Year 3/2009	
		English	Non-English	English	Non-English	English	Non-English
		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Item	**Skills development**	2.74 ± 0.09	2.74 ± 0.17	2.81 ± 0.08	2.76 ± 0.14	2.73 ± 0.09	2.94 ± 0.15
1	I developed critical thinking skills through PBL tutorials	2.85 ± 0.11	3.11 ± 0.20	2.98 ± 0.10	2.94 ± 0.16	2.94 ± 0.09	2.80 ± 0.14
2	I developed problem solving skills in PBL	3.35 ± 0.09	3.56 ± 0.12	2.96 ± 0.09	2.76 ± 0.16	3.00 ± 0.08	3.00 ± 0.16
3	I developed the ability to think laterally in solving problems in PBL	3.24 ± 0.10	3.39 ± 0.16	2.93 ± 0.10	2.82 ± 0.15	2.78 ± 0.08	3.00 ± 0.16
4	I have gained skills in making diagnosis in PBL	2.57 ± 0.12	2.69 ± 0.17	2.98 ± 0.08	2.86 ± 0.16	2.97 ± 0.05	3.07 ± 0.18
5	PBL enhanced my communication skills	3.18 ± 0.10	3.35 ± 0.12	2.77 ± 0.10	2.94 ± 0.16	2.86 ± 0.09	3.00 ± 0.18
	Group process	2.97 ± 0.10	3.13 ± 0.13	2.86 ± 0.07	2.81 ± 0.13	2.69 ± 0.13	2.69 ± 0.15
6	PBL tutorials promote team work	2.89 ± 0.09	3.12 ± 0.14	3.17 ± 0.09	3.06 ± 0.18	3.03 ± 0.10	2.93 ± 0.22
7	The small group setting of PBL encourages the group to share their ideas	2.69 ± 0.11	2.76 ± 0.16	3.07 ± 0.07	2.88 ± 0.12	3.17 ± 0.07	2.87 ± 0.22
8	Everyone in my PBL group contributes significantly to the discussion	2.80 ± 0.11	2.88 ± 0.16	2.22 ± 0.11	2.35 ± 0.17	2.42 ± 0.12	2.33 ± 0.24
9	I like sharing my knowledge with my PBL group	2.90 ± 0.10	2.63 ± 0.17	3.18 ± 0.06	2.94 ± 0.16	3.00 ± 0.07	3.27 ± 0.11
	Learning preference	2.54 ± 0.13	2.78 ± 0.23	2.56 ± 0.12	2.37 ± 0.13	2.26 ± 0.13	2.46 ± 0.25
10	I prefer PBL classes to didactic teaching such as lectures	2.64 ± 0.11	3.18 ± 0.15	2.80 ± 0.11	2.40 ± 0.18	2.42 ± 0.11	2.54 ± 0.16
11	I learn better in a small group tutorial than in a large group lecture	2.88 ± 0.14	3.13 ± 0.21	2.95 ± 0.12	2.94 ± 0.20	2.76 ± 0.12	2.93 ± 0.23
12	I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture	2.92 ± 0.13	2.88 ± 0.27	2.71 ± 0.12	2.50 ± 0.16	2.48 ± 0.11	2.85 ± 0.27
	Tutor practice	2.61 ± 0.12	2.79 ± 0.14	2.61 ± 0.10	2.40 ± 0.25	2.56 ± 0.12	2.80 ± 0.18
13	My tutor promotes a relaxed atmosphere in PBL tutorials	3.28 ± 0.09	3.35 ± 0.17	3.04 ± 0.08	2.67 ± 0.22	3.00 ± 0.09	3.38 ± 0.13
14	My tutor asks lots of questions about the problem being solved	2.56 ± 0.10	2.63 ± 0.12	2.86 ± 0.08	3.00 ± 0.19	2.82 ± 0.06	2.77 ± 0.18
15	My tutor uses questions to keep the group on track	3.18 ± 0.07	3.24 ± 0.13	2.98 ± 0.05	3.00 ± 0.19	3.00 ± 0.08	3.33 ± 0.12
16	My tutor is good at resolving conflicts in the group	2.95 ± 0.09	2.94 ± 0.10	2.72 ± 0.08	2.79 ± 0.17	2.77 ± 0.08	3.00 ± 0.14

The change in perception over time was examined by means of a longitudinal study of the Year 1 students in 2007 who were followed through 2008 and 2009. Table 3.12, which compares the cohorts longitudinally, provides the results of the one-way general linear models testing the year of study effect across the four different learning outcomes or subscales measures: Skills Development, Group Process, Learning Preference and Tutor Practice. Estimated marginal means are then presented in this table (3.12) with the results of post hoc t-tests. Groups sharing the same letter (a or b) represent a homogeneous set so a and b are significantly different set.

Table 3.12: Comparison between the crude effects derived from the one-way general linear models of the years of the study in the cohorts used in the longitudinal study (Year 1/2007, Year 2/2008, Year 3/2009)

	Skills Development (SD)	**Group Process (GP)**	**Learning Preference (LP)**	**Tutor Practice (TP)**
Model (global test)	F=0.083 *p*=0.921	F=4.646 *p*=0.011	F=1.898 *p*=0.154	F=1.741 *p*=0.179
Year 1	10.88	**7.12**[a*]	6.05	6.22
Year 2	11.01	**6.49**[b]	5.76	5.92
Year 3	11.04	6.57	5.46	6.09

**p<0.01, a or b represent a homogeneous set so a and b are significantly different set.*

Of the four learning outcomes or subscales, only Group Process was significantly different across the years of study (F = 4.646, p = 0.011; Table 3.12). On average, students in Year 2 exhibited a difference in Group Process, relative to Year 1 students; however, there were no differences between the students as first years in 2007 and as third year students in 2009, or as second year students in 2008 and third year students in 2009. Further investigation of the 2007 longitudinal cohort is provided in Tables 3.13 and 3.14. Table 3.13 considers the four subscales (Skills Development, Group Process, Learning Preference and Tutor Practice) in terms of the demographics and year of study using general linear models. Table 3.13 illustrates the adjusted effects resulting from multivariable general linear models of SD, GP, LP and TP based on the first entry cohort (those entering first year in 2007).

Table 3.13: Adjusted effects resulting from multivariable general linear (MV) models of SD, GP, LP and TP based on the first entry cohort (those entering first year in 2007, longitudinal cohort)

Effect (Reference)	Skills Development (SD)	Group Process (GP)	Learning Preference (LP)	Tutor Practice (TP)
Gender (Female)	0.57	0.05	-0.62*	-0.03
Age (20+ years old)	-0.52	-0.31	-0.38	-0.17
Education (Graduate)	-0.07	-0.18	-0.02	0.19
Language (Non-English)	0.02	-0.11	0.02	0.07
Year of study (Year 1)	***F=0.233***	***F=3.242****	***F=1.400***	***F=1.399***
Year 2	0.23	-0.54*	-0.27	-0.27
Year 3	0.28	-0.46	-0.52	-0.09
Overall model	**F=0.763 *p*=0.601**	**F=2.132 *p*=0.054**	**F=1.866 *p*=0.092**	**F=0.994 *p*=0.435**

** $p < 0.05$.*

The estimated marginal means (EMMs) for the longitudinal cohort resulting from the multivariable (MV) (adjusted effects) models are shown in Table 3.14. The F-tests for the multi-category predictors (year of study, cohort) and the overall model are also provided in this table. Estimated marginal means (EMMs) in Table 3.14 are derived from the multivariable models (adjusted effects) are provided in Table 3.13, where at least two groups differ. Groups sharing the same letter (a or b) represent a homogenous set so a and b are significantly different set.

Table 3.14: Estimated marginal means (EMMs) for the longitudinal cohort resulting from the multivariable (MV) (adjusted effects) models

Factor	Skills Development (SD)	Group Process (GP)	Learning Preference (LP)	Tutor Practice (TP)
Gender				
Male	10.62	6.61	6.00^{a}	6.16
Female	11.19	6.67	5.37^{b}	6.13
Age group				
16-20 years old	11.16	6.80	5.87	6.23
20+ years old	10.64	6.49	5.50	6.05
Education level				
School-leavers	10.94	6.73	5.70	6.05
Graduate	10.87	6.55	5.67	6.24
Language				
English	10.89	6.70	5.67	6.11
Non-English	10.92	6.58	5.70	6.18
Year of study				
Year 1	10.73	6.97^{a}	5.95	6.26
Year 2	10.96	6.44^{ab}	5.68	5.99
Year 3	11.01	6.51^{b}	5.43	6.18

a or b represent a homogenous set so a and b are significantly different set.

The first thing to note is that none of the multivariable models is significant (Table 3.13) because the overall model F-test is not significant. This suggests that even where a specific effect is identified as significant (i.e. year of study for group process (GP) and gender for learning process (LP)), a conclusion of difference cannot be inferred. In this case, however, these differences will be examined as a probable signal for a likely difference.

Comparing the results of the multivariable analysis (Tables 3.13 and 3.14) with those of the bivariate analysis (Table 3.12), the crude year of study effect shows the effect for adjustment for the demographic variables. Adjustment for gender, age, education level and language does not change the pattern of differences (or non-difference), although adjustment for these potential confounders does change the values of the estimated marginal means relatively.

3.3.4. Summary and interpretation of the longitudinal study

Analysis of the data show that there are differences in process as the student cohort progressed from Year 1 to Year 2. There were, however, no differences in group process between first and third-year students or second and third-year students. Further, when adjustment was applied for age, gender, education level and language, the pattern of differences (or non-difference) did not change, although adjustment for these potential confounders does change the values of the estimated marginal means relatively. This suggests that even where a specific effect is identified as significant (i.e. year of study for GP and gender for LP), a conclusion of difference cannot be inferred. In this case, however, these differences will be examined as a probable signal for a likely difference. Students' perceptions of their learning style, the development of their cognitive thinking skills, problem-solving skills and their interaction and use of interpersonal communication skills with their peers and tutor in PBL group tutorials were assessed using two approaches: cross-sectional and longitudinal. In this research, students' perceptions were ascertained to explore their views toward PBL in order to test the hypothesis proposed and to answer the research questions.

This part of the study was approved by the Bond University Research Ethics Committee and was registered under project protocol RO 647 (Appendix 3).

3.4. Discussion

3.4.1. Overview

In Part A, a questionnaire was developed that would utilise two approaches (cross-sectional and longitudinal) in order to assess students' perceptions of their learning style, the development of their cognitive thinking skills, problem-solving skills and their interaction with the use of interpersonal communication skills with their peers and tutor in PBL group tutorials.

A cross-sectional approach was used to study three cohorts in across three years of study (2007-2009). After analysing the results of the cohorts, this research found that differences in perception were significant in for demographic variable only: Student age. Younger students (16-20 years old) were showing significantly more positive perception towards three of the subscales of PBL examined in this study: Group Process, Learning Preference and Tutor Practice. This was is acknowledged in the literature (Bernstein *et al*., 1995; Miflin, 2004; and Singaram *et al*., 2008). Younger students (16-20 years) perceived themselves as gaining and developing abilities to analyse, solve problems and think laterally more so than did older students (20+ years) did. Additionally, the 16-20 year olds significantly perceived that the learning of the small group depended on group members exchanging thoughts and ideas, collaborating and cooperating while discussing the problem presented during the PBL tutorial more than the older students did. The majority of the first year students agreed that their tutors promoted a relaxed atmosphere during the PBL tutorials compared with Year 2 students. Younger students believed that PBL tutorials enhanced their critical thinking skills and ability to make a diagnosis. These findings were not surprising, as the small size of the tutorials has a major effect on the students' contribution during the discussion and sharing of knowledge. This trend was affirmed by the yielding results; where First year students scored higher than second and third year students. Teamwork was also more clearly and positively perceived as important by the First year students than the second year and third year students in that they approved of sharing knowledge with the other PBL group members. Interestingly, the longitudinal

examination of the data resulted a relative difference (*albeit* not significant) between the various demographic groups.

The anonymity of students meant that somewhat conceivable results from the longitudinal approach were found. Interestingly, first year students were noticed to record higher result values towards the group process predictor and females towards their learning preference, however, significance was not found in these differences.

3.4.2. Gender and perception

Research Question 1 inquired whether gender affects medical students' perceptions of PBL. The results showed, however, that in the cross-sectional study, similarity was found in male and female students' point of views while in the longitudinal study, the Learning Preference subscale was the only factor that was perceived more positively by female than male students.

The findings of this study indicated that similar perceptions toward their engagement in PBL process was found for both genders, in contradiction to most studies which identified differences. The cross-sectional part of this study also showed no significant difference in the perception of males and females toward social aspects of PBL, such as group work, support and collaboration. This contradicted the findings of another researcher, where females are described as connected learners, in that they place more emphasis on listening to achieve a deep understanding of others' viewpoints rather than to verbally critique or dismiss them (Reynolds, 2003). This disparity could be attributed to Bond University medical students being considerate to their colleagues and always trying to achieve the learning issues through seeking group achievement rather than individual success, regardless of diversity. The results of the present study indicate that males showed no significant difference to their female peers‟ in their contribution to PBL discussion and both males and females participated equally and substantially to the discussion based on their perception results. This is contrary to work that argues that males are dominant contributors to PBL discussions (Gilligan, 1982; Belenky *et al.*, 1986; Gawelek *et al.*, 1994; Kaplowitz & Block, 1998; Reynolds, 2003). Moreover, males and females in the current study showed similar perceptions toward sharing information during the

small group settings of PBL tutorials, even though studies have shown that women are likely to exhibit more relational characteristics, such as collaboration and sharing information (Fletcher *et al*., 2000). Additionally, males and females perceived mutually their significant contribution in the discussion and their engagement in the group process, suggesting that each member of the PBL tutorial is respectful of the opinions, thoughts and participation of their colleagues. This is an essential attribute underpinning PBL process and is also recognised in the attributes that Bond University states graduates must have (Chapter 2, Table 2.2). Males and females displayed similar agreement levels in their perceptions toward the tutor facilitation skills, which is contrary to some of the literature outcomes where females were found to believe that their tutors' facilitation affects group participation more than their males' counterparts did (Dolmans *et al*., 2001).

3.4.3. Age and perception

Research Question 1 inquired whether the age factor would affect medical students' perceptions of PBL. It was hypothesized that there will be a difference between younger students' (16-20 years old) and older students' (20+ years old) perceptions. The results showed that younger students significantly perceived the PBL subscales of group process, learning preference and tutor practice differently to older students. Skills development results, however, showed no differences between the two age groups.

In the current study, it was found that the younger (16-20 years) and the Year 1 students were more likely to prefer PBL over didactic lectures. This finding is contradictory to the notion that the transition from a traditional learning method to PBL might cause feelings of insecurity, anxiety and confusion (Caplow *et al*., 1997). The student preference for PBL rather than didactic teaching could be attributed to other findings in the literature, where students found PBL helped them make links between the basic sciences and their clinical work with patients (Barrows & Tamblyn, 1980) and that the preference of younger and First year students to PBL learning was due to their belief that the small group discussions and debate in PBL sessions enhanced higher order thinking and promoted shared knowledge

construction (Blumenfeld *et al*., 1996). PBL is a motivational educational approach and is often more enjoyable for students than didactic learning as it encourages all group members to engage. In this study, younger learners (16-20 years old) perceived that they developed cognitive thinking skills more than older students (20+ years old) did, which is in contrast to that belief that older learners are motivated and carrying the higher order thinking on behalf of younger students (Teakle, 2008). The attitudes of these younger learners supported one of the essential principles of PBL and that was shown when they stated that it enabled them to activate their prior knowledge and build on existing knowledge, utilising their higher order thinking skills. As older learners had more life experience and education, they might have been exposed to a variety of learning methods and may be more used to the conventional methodologies where they are passive learners. Again, the 16-20 year- olds in the current study perceived that they implemented a deeper learning style than students aged above 20 years. This affirms one of the key beneficial aspects of PBL learning, i.e. students interacting with their learning materials, leading to the improvement of their understanding. Thus, these results were contrary to McParland and colleagues' (2004) findings that older students adopt a deeper learning style of understanding for the subject than younger students.

The results of Part A show that younger students preferred the type of self-directed studies carried out in PBL, as it gave them a feeling of self-discipline over their studies, which presumably differed from their high school learning style. They perceived PBL more highly than older students, as younger students regarded PBL approach as a resourceful method of individuality, especially in their learning scope and cognitive skills development. Conversely, in the literature older students were found to be self- directed learners. Distlehorst *et al*.'s (2005) study indicated that mature students may be more likely to seek active learning opportunities in which they can take the responsibility and benefit from the PBL approach. This may be because they believe they do not need to be told what and how to learn. Younger students in the present study preferred the type of self-directed studies carried out in PBL, contrary to the findings in the literature.

Students aged 16-20 years felt more positively than did older students about valuing

a tutor who can keep the group on track by asking appropriate questions. This group also appreciated the personal qualities of the tutor, such as communicating with students in an informal way and the emphatic attitude she or he demonstrated, as these qualities facilitate the creation of a relaxed atmosphere in the PBL tutorial setting that both allowed and encouraged students to exchange knowledge and ideas. This is in line with some of the literature (Yee *et al*., 2006), where younger students appreciated the facilitating qualities of the tutor more than did older students. The findings of Schmidt and Moust (1995), however, show both older and younger students agree on the value of the tutor's facilitation skills.

3.4.4. Educational background and perception

Research Question 1 asked whether education level affects the school-leavers and graduate medical students' perceptions of PBL. It was hypothesized that there would be a difference between those two groups; however, the results showed that the effect is not present unless it is in conjunction with age as a factor. Research Question 2 asked if the students' perception of PBL changes as they progress through their studies (as measured in the students' first, second and third years of study). It was hypothesized that there would be a change between those groups; however, the results did not show any change except for in one predictor, Group Practice, where the effect was greatest in amongst the Year 1 students in both the cross-sectional and longitudinal studies. Therefore, the answer to this question of whether the effect does occur is yes but only in the group practice subscale.

Analysis of the results from the cross-sectional and longitudinal investigation of students' views examining the impact of prior education revealed that First year students believed that the small group discussions and debate in PBL sessions enhanced higher order thinking and promoted shared knowledge construction. In the present study, an interesting finding was that while PBL was originally designed to address the learning needs of the graduate students (Barrows & Tamblyn, 1980), first year students and school-leavers stated strongly that PBL enabled them to acquire extensive and integrated knowledge that could be applied to the analysis of the cases in hand, which is an ideal outcome of the PBL process. Additionally, First year

students' views in the present study were significantly more positive in terms of group process than those of second and third-year students. This agrees with the findings in the literature, where First year students believed that the small group discussion in PBL tutorials enabled them to discuss effectively and improved their ability to formulate and present their personal opinions (McLean *et al*., 2006). Furthermore, students from different education levels in this study agreed that the small group setting of PBL encourages members of the group to share their ideas. This finding is consistent with the views recorded by students with different educational qualifications, who reported an improvement in communication skills because of the PBL experiences of the small group (Cisneros *et al*., 2002; Whelan *et al*., 2002). According to the results of the current study, it was assumed that there was minimal disharmony during PBL tutorials of Bond University medical students. This assumption lead to a positive environment that enabled them to be engaged in more collaboration and elaboration activities in the PBL tutorials and this could contribute to the benefits that the students received from the PBL methodology.

Contrary to the findings in the literature that PBL should be used in the later years of study (Bratt, 2003), the cross-sectional and longitudinal results of the learning preferences of First year students in this study suggest that PBL is best used in the early stages of a course to acquire the foundation factual knowledge for application to practical problems encountered in the later years of their study, rather than the traditional didactic teaching methods. These findings could be because there is a sufficient support to the student learning as the cases might be designed appropriately as PBL is a hybrid approach. Additionally, the results in the present study showed that first year students significantly perceived their tutor facilitation qualities more positively than the second year group, indicating that effective tutor facilitation led to more contribution and interaction in the group setting and promoted a more relaxed atmosphere that encouraged students to participate in the discussion (one of the major outcomes of PBL process). These tutor qualities were similarly appreciated by the first- year students in Yee's colleagues' (2006) study, where students perceived a good tutor as the one who encourages appropriate interactions by maintaining an open and trusting environment. The small group characteristic of PBL is believed to be an effective method for increasing classroom

engagement (Duch *et al*., 2001) and this group interaction could not be achieved unless a skilled facilitator promotes a relaxed atmosphere. The belief of the positive effect of the facilitator on the tutorial atmosphere that was held more strongly by school-leavers and First year students in the present study suggests that this group of students needed more assurance from their teacher or tutor to engage effectively in the group learning activities. It could also mean that these students (school-leavers and first year), having come from a more traditional background, are used to the traditional role of the teacher. This is supported by Das *et al*.'s study, (2002), in which First year medical students, when asked to evaluate the role of their tutors in PBL, they stated that they expected more support from their tutors.

3.4.5. Language background and perception

Research Question 1 asked whether home language affects medical students' perceptions of PBL. Despite the hypothesis that there would be differences between English language speakers and non-English language speakers, the results from Part A of the study showed no differences. This could be attributed to the belief found in the literature that students enjoyed working with their peers from different social and cultural backgrounds (Singaram *et al*., 2008). Additionally, Australia is a multicultural country, with one in four Australian residents born oversees, so Australians are accustomed to diversity. In the present study, no significant differences were detected in the perceptions of non-English and English first language students, as the small PBL environment allows for a focused interchange of knowledge which overcomes many of the hurdles that non-English groups of students might have when communicating. Students from all different language backgrounds participated in the discussion substantially (Mpofu *et al*., 1998). Moreover, students from different cultural backgrounds (as reflected by home language) stated that the small group tutorial facilitates their adaption to new and unfamiliar academic environments, which is in line with the literature where similar groups of students stated that the PBL small group supports individuals in evaluating and refining their learning by providing a setting for interaction with other individuals and in providing collaborative feedback (McLean *et al*., 2006).

Bond University students whose first language was not English perceived that the PBL environment fosters integration and socialisation more than large classes, suggesting that the PBL tutorial context enhanced their learning more than the conventional learning, providing benefits of being comfortable in the small group. This finding is similarly to the views reported by students in McLean *et al*.'s study (2006), where students also believed the small group had a positive effect on their social interaction within their PBL group. Both English and non-English-speaking students in the present study perceived the small group PBL setting as to have played a role in overcoming the cultural barriers and promoting unity and collaborative learning within diverse student groups. This view was also found in Singaram *et al*'s (2008) study, however, contrary to the current study's finding that PBL environment and atmosphere were preferred by both English and non-English home language Bond students, other studies in the literature find that culturally diverse groups preferred to listen to didactic teaching and to learn in a quiet or silent environment (Khoo, 2003). Both English and non-English home language students believed that that their group members were contributing significantly to the PBL discussions. This is one of the advantages of the small PBL environment, when learning is carried out interchangeably and expressively. This contradicted the study in the literature which finds that students from different cultural backgrounds are shy or reluctant to contribute and would not participate in mixed cultures (Bressan, 2005). Additionally, both English and non-English home language students held similar views that their group members were contributing to the discussion and that the small group setting of PBL encourages the group to share their ideas, which is in line with the literature discussed previously. Likewise, the students from different cultural backgrounds in the current study claimed that they were actively involved in PBL and had the benefits of developing their thinking skills and interact actively in PBL tutorials (Mpofu *et al*., 1998; Haghparast *et al*., 2007).

One of Bond University's aims in its mission statement is to advocate the learning equity among its culturally different students. Some of the ways they foster this environment is through the set-up of support networks and societies for non-English speaking groups at Bond University. This equity was evident in the non-English students' perceptions of PBL and was noticeable in the surveyed group of students'

views toward PBL's different aspects particularly the group process and learning preference aspects.

3.5. Conclusions

This Chapter described the selection of the participants and how the sample size was determined for Part A of the study, which focuses on student demographics and their perceptions of PBL. Two approaches (cross-sectional and longitudinal) were applied to analyse the data. The findings from this Chapter were described, analysed and discussed. In summary, age and year of study were the two significant factors resulting from cross-sectional approach. Younger students scored significantly higher than older students in three of the four subscales - Group Process, Learning Preference and Tutor Practice. Younger students preferred PBL more than older students and younger students seemed to engage in discussion more than older students and preferred the traditional role of the teacher or facilitator as a knowledge source rather than knowledge inquirer. Moreover, Year 1 students scored higher in the Group Process and Tutor Practice subscales than Second year students. From the longitudinal approach the overall F-test was not significant, thus suggesting that any specific difference identified as significant (i.e. year of study for GP and gender for LP), cannot be inferred.

The next chapter, Chapter 4, describes Part B of the study: the inventory. The instrument used for this aspect of the study and the findings of the analyses of the videotaping of the PBL tutorial sessions will be discussed. The findings of the correlational association between the learning-oriented discussion of the students and the phases of the end of year assessment based on their demographic characteristics will be described, analysed and discussed in Chapter 4.

CHAPTER 4

PART B

STUDENTS' LEARNING ORIENTED UTTERANCES AND THEIR CORRELATION WITH DEMOGRAPHICS AND ACADEMIC PERFORMANCE

4.1. Introduction

This thesis uses the medical program at Bond University as a case study to explore how demographic variables may affect attitudes towards and participation in PBL to inform the decision to considering the applicability and utility of PBL in an undergraduate Dental Hygiene program in Kuwait. This investigation is divided into two parts. Chapter 3 presented the methods and results relevant to Part A of the study, using a questionnaire to determine the attitudes and perceptions of the students towards PBL . This Chapter explains the methods used in Part B, an observational study and presents the results, focusing on the impact of the students' demographics on their participation by recording students' learning-oriented utterances using a validated instrument (Visschers-Pleijers, 2006;Visschers-Pleijers *et al*., 2003; 2006), which have been described as exploratory questions (EQ), cumulative reasoning (CR) and handling conflicts (HC). The influence of the tutors' intervention on students' verbal interaction and the correlation between students' contribution to the PBL tutorials and their end of year grades is also explored.

Increasingly in higher education, learners are being encouraged to and are expected to learn in a collaborative and interactive environment regardless of their social, educational and ethnic or language backgrounds. The literature draws attention to how collaboration requires an individual to contribute to group learning as well as the individual's own learning within the group (Chizhik, 1998; Kelson & Distlehorst, 2000). Elaboration in the tutorial group can take several forms, e.g. discussion, note-taking, answering questions. Following this process, i.e. discussion, note-taking, answering questions, leads to the construction of richer cognitive models of the problems presented to learners. Moreover, PBL induces cognitive conflict within the group, leading to conceptual change or a restructuring of students' knowledge base (De Grave *et al*., 1996). Students from all backgrounds are usually obliged to participate in PBL in the same way, by sharing their knowledge, research and reasoning (Azer, 2010).

While diversity within the group can increase the range of knowledge and skills available to the group and stimulate divergent thinking, it can, however, lead to

interpersonal conflict which may then inhibit communication and decrease interaction (Nijstad *et al*., 2003). Learning takes place once all the educational circumstances (e.g. knowledge, skills and time) have been met and the PBL session is free from conflict. Interacting in the group not only affirms a student's learning in relation to his or her peers but also gives a student the opportunity to learn about him- or herself (Knowlton, 2003).

In any group, variation in age and life experience is inevitable. While the ability of mature-aged students to build on and incorporate their life experiences in PBL was beneficial (Aldred *et al*., 1997), some older learners stated that they felt the responsibility towards the learning of the younger learners in the PBL class (Teakle, 2008).

Educational background is a variable that can also influence performance in PBL. Van den Hurk and colleagues (1999) found that while students in the later years of their studies are older and have more experience in terms of their learning system, thereby allowing them to carry out their learning tasks according to their learning needs and interest, first year students are still dependent learners and will often stay confined to the learning content.

Two types of skills are necessary if student group work is to deliver its intended outcomes: cognitive skills (analysing cases) and behavioural skills (such as communication and team work) (Willis *et al*., 2002). The individual goals of learning are achieved when the group is working at its optimum and focuses on individual group member's learning activities, stimulated by the group interactions (Dolmans *et al*., 1998). The tutor or facilitator is key aspect to achieving optimal group function. Graham *et al*. (2002) report that tutors who had a non-basic science background were rated just as highly as tutors who had medical training. A study conducted at a Taiwanese University found that students preferred a tutor who had knowledge in both basic and clinical science areas (Lin, 2005). Schmidt *et al*. (1993) report that students guided by experts spent more time on self-directed study and had better achievement scores than those led by non-experts. Kaufman and Holmes (1998), however, found that tutors who rate themselves as content experts had

difficulty maintaining the facilitator role and tended to explain case material more frequently than tutors who had less content expertise. Those studies suggested that the facilitator/tutor can have an influence on students' perceptions of and experience with PBL.

In order to establish the influence of the tutor on the PBL experience, it is necessary to define the role of the tutor in PBL. As discussed in Chapter 2, minimum, a tutor should perform the following functions (Neville, 1999):

- stimulate the linking of old and new knowledge
- stimulate discussion by focused, goal-oriented questions
- help to keep the discussion structured and distinguish main issues and details
- keep to a time schedule to balance the scope and depth of discussion
- avoid talking about the content unless the group becomes silent or side-tracked, and
- make arrangements for dealing with points that remain unclear after the reporting phase.

Using observation to evaluate student performance provides rich qualitative data. Few studies have, however have been conducted that examine students' behaviour during the PBL sessions using videotaping (De Grave *et al*., 1996; Visschers-Pleijers *et al*., 2005; Wun *et al*., 2007). When implementing an interactive type of educational approach such as PBL, assessing students' performance should not only be by means of pencil and paper i.e. traditional method of assessment (Segers, Dochy, & Cascallar, 2003; Gijbels *et al*., 2005), but also include other types of assessment measures such as the learning-oriented utterance instrument used in this study.

Participant observation has been used in a variety of disciplines as a tool for collecting data about people, processes and cultures in qualitative research in order to evaluate the actual engagement of students and development of problem-solving skills (De Grave *et al*., 1996). In education, there has seen an increase in the number of qualitative studies that include participant observation as a way of collecting information. Several studies have investigated students' interaction and engagement

in the PBL groups using a variety of assessment forms including questionnaires, interviews and observation measurement methods (either direct or through recording tools). In this part of the study, a validated coding scheme was used to transcribe students' discussion. In order to answer the research questions, the researcher sought to observe a sample of tutorial groups by videotaping PBL tutorials and linking the Learning-oriented utterances of the tutorial group members with their demographic characteristics. The impact of the tutors' intervention on the group members' discussion is also investigated.

4.1.1. Hypotheses

This research hypothesizes that students' demographic profiles (i.e. gender, age, educational background, home language) has no influence on their participation or contribution during PBL, as measured by their learning-oriented utterances. It is further hypothesized that no correlation exists between students' participation in PBL and the extent to which a tutor intervenes. The third hypothesis is that there is no correlation between students' participation in PBL and their academic performance.

4.1.2. Research Questions

Part B of the research was set out to answer three of the research questions that were designed to test the first hypothesis. Research Question 3 asks: "Do gender, age, educational background and home language influence student participation during PBL tutorials?" while Research Question 4 asks "Does tutor intervention during the PBL tutorials affect or influence students' utterances?" The effect of tutor intervention on the performance of students with different demographic characteristics will be investigated using a validated instrument that qualitatively categories utterances (Visschers-Pleijers, 2006; Visschers-Pleijers *et al*., 2003; 2006).

Finally, Research Question 5 asks: "Is there an association between the students' learning-oriented utterances during PBL tutorials and their academic achievement?" In order to answer this question, the end of year grades were correlated with

students' learning-oriented utterances.

For the purpose of this study, an utterance is defined as an individual message unit that:

- Is expressed by one group member and dealt with one topic (i.e. a change of topic meant the beginning of a new utterance) (Visschers-Pleijers *et al*., 2006); and
- Has one single communicative function, i.e. a single message or expectation that is communicated by the speaker (for example, a question, an argument, an evaluation) (Van Boxtel *et al*., 2000; Rourke *et al*., 2001). The length of an utterance could vary from one word to several sentences.

Utterances in this context are used as a measure of student active participation, rather than passive participation (e.g. listening). This study will investigate the influence of four demographic variables (gender, age, educational background, home language) on students' contributions during the first PBL session of a case. This aspect of the study will also quantitatively and qualitatively documents students' participation and contribution during a PBL tutorial and attempts to correlate this with their final grades.

4.2. Methods

The aim of this aspect of the study was to quantify the qualitatively different interventions of individual students and tutors in their PBL tutorials. Based on the literature (Chapter 2) and the supervisors experience with PBL, it was decided by the researcher and the supervisors that videotaping the PBL sessions would allow the researcher to obtain reliable data. To establish an environment relatively free from confounders (factors that might cause confusion or perplexity), the decision was made to videotape the students in their PBL tutorial rooms without the physical attendance of the researcher, since her presence might impact on verbal interaction and impede the natural flow of the discussion. Filming was therefore undertaken in a PBL tutorial room with an installed camera.

After videotaping PBL tutorial groups, the number and type of verbal learning-

oriented utterances were counted and correlated with the final summative assessment. This study was undertaken with both Year 1 and Year 2 students. The taping was conducted while the first year students were in the sixth week of the second semester and the second year groups in the fifth semester of their studies (2008). This time was chosen as it was deemed that group members were sufficiently comfortable and likely to be in the "norming" and "performing" stages (Tuckman, 1965). The other aspect of the study involved the collection of the end of year (phase) grades from the same group of students: Phase I grades for first year students and the average of Phases I and II for second year students (Table 1.1; Chapter 1).

4.2.1. Part (I): Instrument used to quantify utterances

A validated instrument of learning-oriented interactions (Visschers-Pleijers, 2006; Visschers-Pleijers *et al*., 2003; 2006) was selected. This instrument allowed quantification of qualitatively different utterances of both students and tutors. Utterances were classified as exploratory questioning, cumulative reasoning or handling conflicts (Table 4.1).

Table 4.1: Learning-orientated interactions *(Visschers-Pleijers, 2006; Visschers- Pleijers et al., 2003; 2006)*

Subcategory	Explanation	Examples
Exploratory question (EQ)	Group members engage critically but constructively with each other's ideas by asking higher order questions or by providing and considering alternative explanations.	1. Students asked questions that were relevant for obtaining a good understanding of the subject (e.g. they asked about characteristics, different meanings, reasons, concrete examples). (open questions) 2. Probing questions were asked by group members to scrutinise students' observations. (critical questions) 3. When a student was given an explanation with respect to the problem, s/he regularly asked other students whether they thought the explanation was accurate. (verification questions) 4. The group was not satisfied with just one explanation. Alternative explanations were also suggested. (alternative arguments)
Cumulative reasoning (CR)	Group members build positively but uncritically, on what is said by a group member. This may lead to an automatic consensus and group members construct a "common knowledge" by accumulation. A logical extension of a previous utterance	1. Group members built on the ideas that were put forward. (arguments in general) 2. Observations that were put forward were supported by arguments. (arguments reason)

	reflecting reasoning and which turns out to be an active way of formulating things and thinking aloud, e.g. continuation arguments, reasons, conditional arguments and conclusions.	3. Students' explanations led to additional explanations by other students. (Continuation arguments). 4. Conclusions were drawn from the information discussed in the group. (conclusive arguments)
Handling conflicts (HC)	Group members acknowledge and discuss contradictory information, characterised by expressing disagreement, negation of previous utterances and/or counter arguments.	1. Contradictory ideas or information concerning a subject were discussed in the group (one student introduced contradictory information or different students put forward different information or ideas. (conflicts on knowledge) 2. One student or several students was/were contradicted by the others. (negations) 3. When students expressed disagreement with regard to information presented by another student, they explained why they disagreed. (counter-argument)

4.2.1.1. Recruitment of participants

Twelve PBL tutors who facilitated the eighteen Year 1 and Year 2 PBL groups were emailed to explain the purpose of the study. Their permission was sought to attend the commencement of a tutorial to provide a brief presentation similar to the one explained in Chapter 3 and found in consent forms (Appendices 4 and 5).

All tutors agreed to the researcher attending. The researcher organised the timeline of the presentations to the 18 PBL groups, (some first and second groups are facilitated by one tutor) to establish a feasible time for the tutor to prepare his/her students. The researcher recruited participants by presenting the study to all PBL tutorial groups. Consent forms (see Appendices 4 and 5) explaining the purpose of the study and the data that would be gathered (e.g. videotaping; use of end of phase grades) were distributed to the 18 tutorial groups, comprising 7-9 students. For the study, the recruitment policy stated that if 20%r cent of the group refused to participate, then the whole group would not be used in the study. An explanation would then be provided to those group members who had agreed to participate. After collecting the consent forms, groups containing fewer than seven members were excluded. Five groups agreed to be videod and were eligible to participate (two Year 1 groups Year 1 (n = 14); three Year 2 groups Year 2 (n = 24)). A short

questionnaire requesting demographic information was administered (Table 4.2). The case opening session was selected as it was deemed that as all students in this session would be new to the case, they would all be going through the PBL steps of activating prior knowledge and experience, generating hypotheses and identifying gaps in knowledge.

Table 4.2: Demographic representation of Year 1 (two groups) and Year 2 (three groups) students who agreed to participate (n = 38)

Demographic	**% Year 1 (*n* = 14)**	**% Year 2 (*n* = 24)**	**% Cohort Year 1 (*n* = 92)**	**% Cohort Year 2 (*n* = 87)**
Gender				
Male	43.0 (*n* = 6)	42.0 (*n* = 10)	43.5 (*n* = 40)	58.6 (*n* = 51)
Female	57.0 (*n* = 8)	58.0 (*n* =14)	56.5 (*n* = 52)	39.1 (*n* = 34)
Age				
16-20 years old	43.0 (*n* = 6)	33.0 (*n* = 8)	72.8 (*n* = 67)	71.3 (*n* = 62)
20+ years old	57.00 (*n* = 8)	67.00 (*n* = 16)	27.20 (*n* = 25)	28.70 (*n* = 25)
Education level				
School-leavers	50.0 (*n* = 7)	54.0 (*n* = 13)	59.9 (*n* = 55)	67.8 (*n* = 59)
Graduate	50.0 (*n* = 7)	46.0 (*n* = 11)	40.2 (*n* = 37)	31.0 (*n* = 27)
Language				
English	71.0 (*n* = 10)	79.0 (*n* = 19)	75.0 (*n* = 69)	67.8 (*n* = 59)
Non-English	29.0 (*n* = 4)	21.0 (*n* = 5)	25.0 (*n* = 23)	31.0 (*n* = 27)

4.2.1.2. Data collection

The researcher remained in the remote videotaping control room for the duration of the recording. Each student had a badge with a unique identifier. Students' names remained anonymous to the researcher but were known to the tutorial organising administrator who did not have access to the videotapes. This staff member subsequently provided the de-identified assessment results (grades) for the last part of the study.

To guarantee an undisputable starting point for students in all groups, the case

opening session (Day 1) was selected as the context of analysis. Although sessions are usually two hours but the time was adjusted to include only the periods of the learning-oriented utterances (approximately 90 minutes). Detailed field notes in terms of the learning-oriented utterances were taken when the researcher watched the recording of the PBL sessions.

4.2.1.3. Calibration of the scoring

The scoring system using the measurement instrument was validated by three facilitators, a supervisor and the researcher prior to the final analysis. Before meeting, the panel of intra-raters (supervisor and three facilitators) and the researcher viewed an example of a videotaped PBL tutorial session independently. During the subsequent meeting, the panel viewed 15 minutes of the videotaped PBL tutorial session, each identifying and categorising the utterances. Their coding and scoring was then discussed and differences resolved. There was approximately 90% agreement amongst the different scorers, suggesting. Once satisfied with the validation of her scoring, the researcher then viewed and coded another 15 minutes segment of the video footage. The scoring was discussed with the supervisor to ensure that the results were valid.

4.2.1.4. Data analysis

The videotapes were viewed and the types of learning-oriented utterances were noted for each student and the tutor. A map of the conversation was produced based on 15-minute segments of the video for each participant. In this way, the verbal contribution of each student and the tutor during that time was documented. Each student's utterances were transcribed on the inventory sheet by observing each student in turn and recording how often their contributions could be assigned one of the learning-oriented utterances. The same was done for the tutor. The researcher adjusted the calculations for each individual based on the duration of the tutorials for the different groups. While analysing students' learning-oriented utterances, the field notes taken during the original recording of the tutorials were used to improve the analysis and measurement of the learning-oriented utterances and to provide more in-depth description of the verbal interactions occurring during PBL.

4.2.1.5. Statistical analysis

A number of statistical tests were used to analyse the data. First, the crude effect differences (e.g. differences between the sample means) that were derived from the bivariate model were calculated at the beginning of the analysis. This is because that they can be misleading as there are other types of differences that get mixed up with (confound) factors such as the year-of-difference effect. Poisson regression methods that are typically used to predict counts of (rare) events were also given a set of predictors. This approach enables the researcher to concentrate on describing the relation between the dependent variable (students' participation and the academic achievement) and the predictor variables (demographic characteristics) through the regression model. The adjusted effects that were derived from the multivariable models (e.g., the year of study effect adjusted for gender, age, education level, language) for each factor were then calculated. One of the Measures of Relative Standing was used to provide information about where a particular score (Z-score) falls in relation to the other scores in the distribution of data. The Z-score was used to indicate how many standard deviations (SD) a raw score falls from the mean. An F-test was also performed with some of the statistical methods to test the global hypothesis of group equality. Then, the Estimated Marginal Means (EMMS), are the adjusted means, were calculated. Finally, Pearson correlation coefficients were used to explore any association or correlation between students' utterances and their demographic characteristics. The correlation coefficients (r) that result are one of the following r values: strongly positive ($r > + 0.5$), weakly positive ($r < + 0.5$), weakly negative ($r > - 0.5$), strongly negative ($r < - 0.5$) and no correlation ($r = 0$). The statistical methods described are standard for this type of study. The research data were analysed using SPSS (Statistical Package for the Social Sciences, Version 21.0).

4.2.2. Part (II): Correlation between utterances and end of year (phase) grade

A copy of students' end of year grades results for the five PBL groups who participated in the study (Table 4.3) was obtained from an appointed administrator. Consent forms for this part of the study had been collected previously (Appendix 4;

Section 4.2.3). The purpose of collecting the final year or end of phase grades was to investigate the association between students' learning-oriented utterances and their academic achievement.

4.2.2.1. Participant demographics

Table 4.2 shows the demographics of the participants in this part of the study (n = 38; Year 1 n = 14; Year 2 n = 24).

4.2.2.2. Statistical analysis

The following statistical tests were used to analyse the data in this part of the study. First, the crude effect differences (for example, differences between the sample means) that were derived from the bivariate model were calculated at the beginning of the analysis. The Adjusted effects were then calculated. The Z-score was also used. Additionally, an F-test was performed. Then, the Estimated Marginal Means (EMMS) were calculated. Finally, Pearson correlations coefficients were used to explore any association or correlation that could be found between the students' learning utterances and tutor utterances or the student's learning-oriented utterances and their end of year assessment results. The research data were analysed using SPSS (Statistical Package for the Social Sciences, Version 21.0).

4.3. Results

The relationship between students' demographics (year of study, sample group, gender, age, education level, home language) and the mean of learning-oriented utterances were illustrated in Table 4.3. Moreover, the mean of student utterances are correlated with their end of year (phase) grades in table 4.3. Phase I cumulative results (obtained at the end of Semester 3) and Phase II cumulative results (obtained at the end of Semester 7) were collected. The end of year (phase) grades were correlated with the results of the instruments for each group member. For Year 1 students, their final grade comprised Phase I of end of year (phase) assessment grades only (Table 4.3). For Year 2 students, their final grade comprised the average of Phase I (end of third semester) and Phase II (end of the seventh semester)

assessment grades (Table 4.3). The reason for selecting this correlation alignment is that first year students were in Semester 2 and the next phase of their results was Phase I end of year (phase) assessment grades. Year 2 students were in the fifth semester of their studies (almost in the middle of their studies) so it was more statistically desirable to use the average of the two phases (I+II) of the end of phase assessment grades for correlation purposes.

Table 4.3: Participants' demographics, Mean of learning-oriented utterances and the end of year (phase) grades

Year 1 students	**Mean of learning-oriented utterances**	**Final Grades**
Y1G2M1A1ED1ENG	0.27	85.34
Y1G2F1A1ED1ENG	1.23	84.25
Y1G1F1A1ED1ENG	0.52	83.15
Y1G1F2A2ED2ENG	0.20	80.67
Y1G1F3A2ED2ENG	0.02	76.51
Y1G2F2A1ED1ENG	0.09	76.33
Y1G1M1A2ED2NON- ENG	0.22	73.83
Y1G1F4A1ED1ENG	0.57	73.78
Y1G2M2A2ED2NON- ENG	0.20	70.71
Y1G2M3A1ED1NON- ENG	0.89	68.51
Y1G1M2A2ED2ENG	0.18	68.43
Y1G1M3A2ED1ENG	1.06	68.11
Y1G2F3A2ED2NON-ENG	0.20	61.99
Y1G2F4A2ED2ENG	0.19	61.81
Year 2 students		**Final Grades**
Y2G3M1A1ED1NON- ENG	0.66	81.50
Y2G2F1A1ED1NON-ENG	0.28	79.00
Y2G2F2A1ED1ENG	0.96	76.50
Y2G1F1A2ED2ENG	0.34	76.00
Y2G2M1A1ED1ENG	0.33	75.50
Y2G1F2A2ED2ENG	0.33	74.31
Y2G3F1A1ED1ENG	0.89	72.50
Y2G1M1A2ED2ENG	0.51	71.00
Y2G3M2A1ED1ENG	0.17	69.50
Y2G3F2A2ED2ENG	0.21	69.00
Y2G2F3A2ED2ENG	1.06	68.50
Y2G2M2A2ED2ENG	0.26	67.50
Y2G1M2A2ED2ENG	0.29	67.00
Y2G2F4A2ED2ENG	0.11	67.00
Y2G1M3A2ED2NON- ENG	0.31	66.50
Y2G1F3A2ED2ENG	0.39	66.00
Y2G3F3A1ED1ENG	0.01	66.00

Y2G3F4A2ED2ENG	0.14	66.00
Y2G3F5A2ED2ENG	0.12	66.00
Y2G3M3A1ED1ENG	0.36	65.00
Y2G2F5A2ED2ENG	0.36	64.00
Y2G3M4A2ED2ENG	0.24	63.50
Y2G1F4A2ED2NON-ENG	0.86	62.50
Y2G2M3A2ED1NON-ENG	0.08	60.50

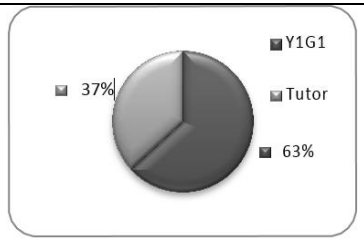
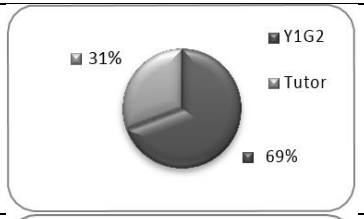
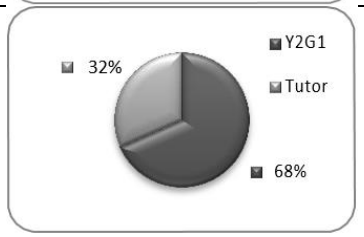
Y1G1F1A1ED1ENG= Year 1, Group1, Female#1 in group, Age 1 (16-20 years old),ED1(School-leavers), ENG = English language background; Y2G1M3A2ED2NONON-ENGLISHLISH= Year 2, Group1, Male#3 in group, Age 2 (20+ years old), ED 2 (Graduate), NON-ENG = non- English language background. Grades are listed in descending order for each group.

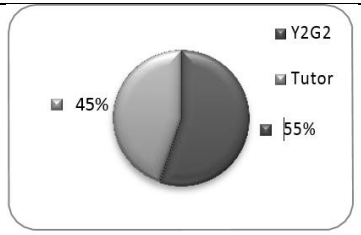
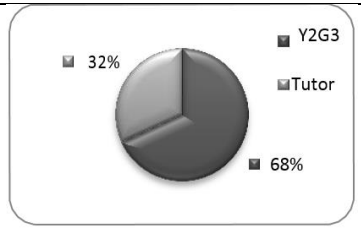
In order to evaluate the students in their use of exploratory questioning (EQ), the development of their cumulative reasoning (CR) skills and their ability to handle conflicts (HC) through the verbal interactions occurring during tutorials, students' learning-oriented utterances frequencies of each type during the tutorial session were scored using the valid instrument and were examined in relation to the demographic characteristics. Tutors' utterances were also recorded and compared with the students' utterances. The magnitude (value of correlation ≥ 0.5 or value of correlation ≤ 0.5) and direction (negative - or positive +) of association detected between students' utterances and their end of year assessment results was investigated along with the influence of the tutor's utterance on students' utterances. Tables 4.4-4.12 reflect the statistical analysis applied to examine the associations and influences of student utterances according to the four demographic characteristics used in this research: gender, age, educational level and language background.

4.3.1. Influence of demographics on participation

Table 4.4 represents the descriptive analyses transcribed after analysing the videotaped tutorial groups. It illustrates the aggregated utterances for students and tutors from the Year 1 and Year 2 study groups.

Table 4.4: Descriptive and statistical analysis of the aggregated students and tutor learning-oriented utterances in all groups

Group	Percentages of student and tutor utterances during PBL tutorials	Descriptive analysis of the field notes recorded while watching the videotaped PBL sessions
Y1G1		• Students from health professions backgrounds or who had completed a graduate degree were noticed to dominate the discussion and forced their new knowledge on the interaction occurring in PBL tutorial. • The tutor advised the dominating students to allow their peers to participate and to give them an opportunity to contribute to the discussion; however, the dominating students did not follow the tutor's advice. • Tutors in this group tried to encourage silent or shy students to contribute to the discussion by asking them open questions about the general arguments. • Students of this group directed most of their questions to the knowledgeable students rather than the tutor.
Y1G2		• Students in this group mostly directed their questions to the tutor instead of their peers. • Students from medical backgrounds or who had completed a graduate degree were noticed to dominate the discussion and forced their new knowledge to the interaction occurring in PBL tutorial.
Y2G1		• Students in this group were the source of most of the general arguments rather than the tutor. The tutor organised and allocated roles to each of the students. • Tutor tried to accelerate the functionality of the group when the chair person was reluctant to perform her duties.

Group	Percentages of student and tutor utterances during PBL tutorials	Descriptive analysis of the field notes recorded while watching the videotaped PBL sessions
Y2G2		• Students mostly directed their open and critical questions to the tutor instead of their peers. • The tutor used a remarkable technique when asking questions in that the tutor was providing a fact or an idea and then deriving the question from it. • It was noticed in this group that the tutor provided most of the general arguments and thus the students were reluctant to provide a summary of the case at the end of the tutorial. In contrast, this was an easy task for the other two groups. • The predominant tutor who adopted an assertive facilitation style prevented students from engaging critically and positively in the constructive higher order thinking.
Y2G3		• The students in this group were the source of most of the general arguments rather than the tutor. • The tutor was asking questions by providing a fact or an idea and then deriving the question from it. • The tutors of this group tried to encourage silent, withdrawn or shy students to contribute in the discussion by asking them about general arguments or providing them with a feedback concerning their contribution. • The tutor in this group attempted to involve the silent students by encouraging them to retrieve the resources found in the tutorial room (since the tutor noticed the lack of prior knowledge of this student).

4.3.2. Description of the field notes recorded when watching the videotaped PBL tutorials

As discussed in Table 1.2 (Chapter 1), during Day 1 of PBL, students are exposed to problems, with "triggers" which require them to learn how to use intellectually engaged higher order thinking sequentially revealed. First, students identify and clarify unfamiliar terms presented in the case scenario. This research showed that second year students were using the tutorial time more efficiently in that they devoted less time to reading triggers than the first year students, who spent more time reading and explaining the triggers. Then, in all groups, the students drew on each other's knowledge and examined areas in which their knowledge was insufficient, attempted to develop learning issues and negotiated the strategies for learning. As noted from the videotaped sessions (Table 4.4), certain students and tutors in some groups dominated the discussion. It was noted that the first year students seemed more dependent on their dominant peers throughout the discussions, however, second year students seemed to be independent in their group work and were more relaxed and organised. In contrast to the first year students, more non-dominant students were found in the second year PBL tutorial group discussions. Moreover, second year students seemed to use the appropriate higher order thinking exploratory questions and knew how to ask ordinarily about the case in hand. Additionally, they mostly recognised which resources to use.

The third step in PBL Day 1 involves brainstorming to generate ideas about the problem(s), with students suggesting possible explanations on the basis of prior knowledge or experience. Students then provide explanations which can lead to tentative solutions. This was not, however, demonstrated in the first year group, as the presence of the dominant students prevented other students from demonstrating their cognitive thinking skills. This is because the dominant students provided ready explanations, thereby preventing the other first year students from contributing significantly. After the brainstorming step, the group organises their explanations and restructures their hypotheses and findings if necessary. As knowledge is forced and explanations are readily provided by the dominant students, the other first year students were deprived of the opportunity to identify the gaps in their knowledge and

were not able to utilise their critical and problem-solving skills.

One outcome that these videotaped sessions revealed was that content expert tutors tend to use their subject matter expertise more to direct the discussion in the tutorial group. Although the reflection time is one of the steps in Day 2 of PBL, the second year student groups had feedback or reflection time allocated at the end of the tutorial where they presented their comments and suggestions to their peers, which was thought to be useful for improving any deficiencies they had, whereas, first year student groups lacked this step as it was not part of the PBL tutorial activities in Day 1 of PBL tutorials.

Handling conflicts and contradictory knowledge utterances were not encountered as some students appeared anxious and hesitant to contradict any of the arguments provided, especially in the groups that included dominant students. It was generally noted that most of the groups of students devoted the majority of the session time towards the other two learning-oriented activities, i.e. exploratory questions and cumulative reasoning.

It was noted that the descriptive analysis of the field notes for student and tutor utterances were not highly relevant to the results obtained from the statistical analysis. A descriptive and statistical analysis for each participant based on the three types of learning-oriented utterances – exploratory questions (EQ), cumulative reasoning (CR), and handling conflicts (HC) – is displayed in Appendix 6.

The mean of the learning-oriented utterance total frequencies data (individual and aggregated-raw data) in terms of students' demographics, including year of study are shown in Tables 4.5a-d. The mean utterance data (individual and aggregated) for the students and tutors associated with each group are provided in Table 4.5. Exploratory questions (EQ) and cumulative reasoning (CR) utterances made up the majority of recorded utterances, while handling conflicts (HC) utterances formed the least significant range of the utterances.

Table 4.4.a: Statistical differences between the Mean of learning-oriented utterances and Standard Errors (ER) of the subscales (EQ, CR, and HC) and aggregated learning-oriented utterances results illustrated according to students' gender

	Year 1		Year 2	
	M	F	M	F
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
EQ	0.09 ± 0.00	0.09 ± 0.01	0.05 ± 0.00	0.10 ± 0.01
CR	0.41 ± 0.04	0.23 ± 0.05	0.48 ± 0.05	0.36 ± 0.03
HC	0.03 ± 0.01	0.02 ± 1.36	0.01 ± 0.00	0.01 ± 0.00
Aggregated	0.53 ± 0.04	0.33 ± 0.81	0.53 ± 0.06	0.46 ± 0.03

For the exploratory questions learning -oriented subscale, male and female students displayed similar interaction levels in Year 1 of the study while in year two of the study females interacted using this type of learning utterance more than their male peers. Males in Year 1 and Year 2 of the study utilised their cumulative reasoning skills more frequently than their female peers. Again, males handled conflicts occurring during the PBL tutorials more than their female peers. Males performed at a higher level in the aggregated learning-oriented utterances than their female colleagues in the two years of the study as shown in table 3.11.

Table 4.4.b: Statistical differences of the Mean of learning-oriented utterances and Standard Errors (ER) of the subscales (EQ, CR, and HC) and aggregated learning-oriented utterances results illustrated according to students' age

	Year 1		Year 2	
	16-20	20+	16-20	20+
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
EQ	0.13 ± 0.04	0.06 ± 0.02	0.09 ± 0.04	0.06 ± 0.02
CR	0.38 ± 0.14	0.25 ± 0.09	0.41 ± 0.08	0.29 ± 0.05
HC	0.03 ± 0.02	0.02 ± 0.01	0.00 ± 0.00	0.01 ± 0.00
Aggregated	0.54 ± 0.10	0.33 ± 0.58	0.51 ± 0.08	0.35 ± 0.05

While students aged above 20 years in Year 1 and 2 of the study participated similarly and asked exploratory questions on the same level, younger students (i.e. 16-20 years), asked more exploratory questions than their peers. Younger students (16-20 years) again utilised their cumulative reasoning skills more than did their older (20+) peers in Year 1 and 2 of the study. It was noticed that younger students of first year groups participated less frequently than did their second year younger counterparts. The group that handled conflicts better than the other was the first year younger students (i.e. 16-20 years) compared with students older than 20 years. The resultant aggregated learning-oriented utterances mean was higher in younger

student (16-20 years) groups than their older counterparts (20+ years) in Year 1 and 2 of the study.

Table 4.4.c: Statistical differences of the Mean of learning-oriented utterances and Standard Errors (ER) of the subscales (EQ, CR, and HC) and aggregated learning-oriented utterances results illustrated according to students' education level

	Year 1		Year 2	
	School-leavers	Graduate	School-leavers	Graduate
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
EQ	0.13 ± 0.11	0.04 ± 0.01	0.08 ± 0.03	0.06 ± 0.03
CR	0.44 ± 0.13	0.17 ± 0.06	0.38 ± 0.08	0.30 ± 0.06
HC	0.04 ± 0.02	0.01 ± 0.00	0.00 ± 0.00	0.01 ± 0.00
Aggregated	0.61 ± 0.10	0.22 ± 0.04	0.46 ± 0.07	0.37 ± 0.05

School-leavers participated more frequently and asked more exploratory questions than did their graduate colleagues in both Year 1 and Year 2. Similarly school-leavers in both years of the study utilised their cumulative reasoning skills more frequently than their graduate peers. Yet again, School-leavers handled conflicts more than their graduate counterparts in year one and two of the study. The aggregated learning-oriented utterance performance analysis of the School-leavers yielded the same results.

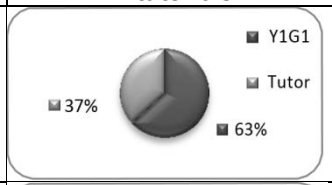
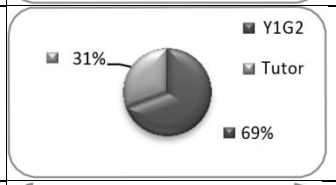
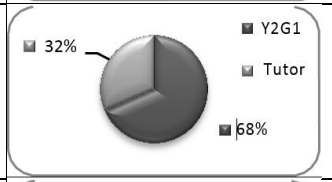
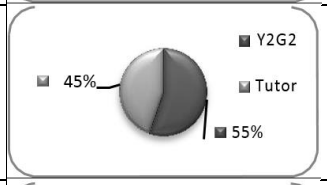
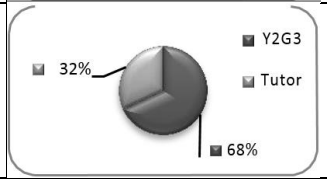
Table 4.4.d: Statistical differences of the Mean of learning-oriented utterances and Standard Errors (ER) of the subscales (EQ, CR, and HC) and aggregated learning-oriented utterances results illustrated according to students' language

	Year 1		Year 2	
	English	Non-English	English	Non-English
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
EQ	0.10 ± 0.03	0.07 ± 0.01	0.06 ± 0.02	0.12 ± 0.08
CR	0.28 ± 0.10	0.38 ± 0.15	0.33 ± 0.05	0.32 ± 0.08
HC	0.02 ± 0.01	0.02 ± 0.01	0.01 ± 0.00	0.00 ± 0.00
Aggregated	0.40 ± 0.07	0.22 ± 0.11	0.40 ± 0.05	0.44 ± 0.07

While the first year English home language students participated more frequently and asked more exploratory questions than their non-English home language peers in Year 1 of the study, the second year non-English home language students asked more exploratory questions than did their English-speaking peers. The non-English home language students utilised their cumulative reasoning skills more frequently than their English home language peers in Year 1 of the study while in Year 2 of the study both groups interacted and used their cumulative reasoning skills on approximate levels. Both groups in the two years of the study handled conflicts

similarly and at low level. When analysing the aggregated learning-oriented interaction it was found that first year English home language group participated more frequently than their peers in the same year of the study while an opposite scenario was shown for the second year students where non-English home language students interacted more frequently than their English home language peers.

Table 4.5: Group mean for student and tutor learning-oriented utterances by group and students' grades

Group	Exploratory Questions (EQ)	Cumulative Reasoning (CR)	Handling Conflicts (HC)	Total Utterances Of Students in group	$Utterance_Z$	Grades	EQ Tutor	CR Tutor	HC Tutor	Total Utterances Tutor	Percentages of student and tutor utterances during PBL tutorials
Y1G1 (*n* = 7)	6.7	27.3	1.6	35.6	0.48	74.9	107	38	0	145	
Y1G2 (*n* = 7)	9.4	27.7	2.3	39.4	1.12	72.7	74	45	3	122	
Y2G1 (*n* = 7)	8.4	30.0	0.6	39.0	-0.35	69.0	107	18	1	126	
Y2G2 (*n* = 8)	4.0	33.8	0.8	38.5	-0.02	69.8	178	71	0	249	
Y2G3 (*n* = 9)	6.4	28.8	0.2	32.4	-0.9	68.8	95	42	0	137	

Note: Y#G#: Y represents year of study, G represents group number, e.g. Y1G1=Year 1, Group 1. Groups Y1G1 and Y1G2 represents the two groups of the Year1 and Groups Y2G1, Y2G2 and Y2G3 represent the three second year groups.

There is no clear significant pattern in the average exploratory questions (EQ) and cumulative reasoning (CR) utterances between the different study years. The results in shown in Table 4.5 suggest that handling conflict (HC) utterances were somewhat higher amongst the first year than the second year groups (raw data). Interestingly, a similar trend (where HC utterances were somewhat higher in first year than second year groups) was reflected in the differences in patterns between the two different measures of aggregated student utterances. The raw utterance score (Table 4.5) shows no visible difference between first and second year students. This is likely to be due to the domination of this measure by cumulative reasoning (CR) utterances, and to a lesser extent, exploratory questions (EQ) type utterances. In the standardised measure of student-aggregated utterances (where all three utterances equally contribute), the first year groups scored higher than the second year groups. Pearson correlation coefficients for the various utterances types (individual and aggregated) and student grades are displayed in Table 4.6.

Table 4.6: Pearson's correlation coefficients for individual and aggregated (total) utterances for students and tutors and student grades

	Exploratory Questions (EQ) Students	Cumulative Reasoning (CR) Students	Handling Conflicts (HC) Students	Total Utterances of students	Utterances Standardized	Exploratory Questions (EQ) Tutor	Cumulative Reasoning (CR) Tutor	Handling Conflicts (HC) Tutor	Total Utterances Tutor
Cumulative Reasoning (CR)	0.467								
Handling Conflicts (HC)	0.383	0.689							
Total Utterances of students	0.680	0.964	0.724						
Utterances Standardised	0.442	0.854	0.966	0.866					
EQ Tutor	-0.200	0.115	-0.120	0.022	-0.045				
CR Tutor	-0.168	0.069	0.016	0.006	0.037	0.677			
HC Tutor	0.183	-0.017	0.241	0.058	0.167	-0.561	-0.201		
Total Utterances Tutor	-0.203	0.109	-0.077	0.020	-0.016	0.964	0.848	-0.461	
Grades	0.085	0.218	0.188	0.208	0.213	-0.091	-0.004	0.087	-0.066

The correlations among the individual utterance types are moderate to high (range = 0.383-0.689). As the individual utterances were combined to obtain the aggregated utterance, it is not surprising that individual utterances correlated strongly with both the raw and standardised versions of the aggregated utterances. Similar to the students' results, tutor utterances also correlated at moderate levels. In contrast to the students' results, however, there were negative associations among some of the tutor utterances types. In particular, tutors with higher numbers of handling conflict (HC) utterances had correspondingly low exploratory questions (EQ) and cumulative reasoning (CR) utterances (Table 4.6). There is little evidence of an association between the aggregated student and tutor total utterances (Table 4.6). In terms of correlations between student utterances, there appeared to be a weak positive association between student and tutor handling conflicts (HC) utterances and a weak negative association between student and tutor exploratory questions (EQ) utterances.

Crude individual effects derived from the bivariate models and provide the crude associations of the various individual predictors (demographic characteristics, i.e. gender, age, education level, home language) with EQ, CR and HC utterances (Table 4.7). The coefficients for EQ and CR are from general linear models and represents the difference in effects (from Crude Individual effects), and values associated with HC represent the Incidence rate ratios from a Poisson regression (generalised linear model with a log link and the assumption of a Poisson-distributed outcome).

The reference factor (e.g. Year 1) in these tables (4.7, 4.8) is the factor that forms the referent of the statistical calculation. If the reference factor in Tables 4.7 or 4.8, is displayed with a negative sign (-) it indicates that the reference factor has a lower value than the other factor and if it is displayed without a sign it indicates that it will have a higher value than the other factor. The resulting values of the adjusted differences (Table 4.8, e.g. year of study = 1.05) between the Estimated Marginal Means (EMMS) are illustrated in Table 4.9. An example from these table explaining the interpretation; the reference factor was Year 1 and the adjusted effect difference =1.05 (Table .8); the resulting EMMS values were Year 1= 8.57, and Year 2 = 7.52 (Table 4.9).

Table 4.7: Crude individual effects derived from the bivariate models of the various demographic characteristics on the EQ, CR and HC learning-oriented utterances

Effect (Reference)	Exploratory Questions (EQ)	Cumulative Reasoning (CR)	Handling Conflicts (HC)
Year of study (Year 1)	1.86	-2.17	0.26***
Group of study (Y1G1)	F= 0.146 p = 0.766	F= 0.146 p = 0.963	χ^2_{LR}=20.426 p < 0.001
Y1G2	2.71	0.43	1.45
Y2G1	1.71	2.71	0.36
Y2G2	2.71	6.46	0.48
Y2G3	-0.27	-1.51	0.14*
Gender (Male)	-4.14	2.06	1.31
Age group (20+)	-4.69	-11.07	0.68
Education level (Graduate)	-4.5	-12.97	0.36**
Language (Non-English)	2.18	2.94	0.59

*Y#G#=Y is year of study, G is the Group observed in that year of study. ***p < 0.001, **p < 0.01, and *p <0.05.*

There was no significant different between group variation in the exploratory questions (EQ) and cumulative reasoning (CR) utterances (all $p > 0.05$) when comparing the years of study. There were a number of significant crude associations for handling conflicts (HC). The incidence rate of HC utterances of second year students was 74% less (HC=0.26) relative to first year students. Education level was also revealed to be a significant effect, with those in the higher education (graduate) group having 64% less (HC=0.36) HC utterances than the lower education (school-leavers) group. There was also a significant group effect, with those in the Y2G3 group (a second year group) exhibiting a considerably lower rate of HC utterances relative to the referent (first year groups; IRR=0.14, $p < 0.05$). Indeed, all of the second year groups (groups Y2G1, Y2G2, and Y2G3) exhibited lower HC utterances than both first year groups (as supported by the significant year of study effect) but only the one group could be shown to have a significant difference in the incidence of HC utterances: the aforementioned third second year group (Y2G3), however, it should be noted only Y2G3 group showed a significant lower incidence of utterances ($p < 0.05$) relative to the first group.

The adjusted effects of the various predictors (demographic characteristics of gender, age, education level and home language) of EQ, CR and HC are provided in Table 4.8. It is important to note that both the tutor and group effects did not cross with at least one of the other predictors (demographic characteristics: gender, age,

education level and home language) in the multivariable models. For this reason, association of these factors was only considered at the crude (bivariate) level only. Adjusted effects of individual predictors (demographic characteristics i.e. gender, age, education level and home language) on the learning-oriented utterances; EQ, CR and HC (Table 4.8); Coefficients for EQ and CR are from a multivariable general linear models and represents the difference in score (from the referent) and values associated with HC represent the Incidence Rate Ratio (IRR) from a multivariable Poisson regression (generalised linear model with a log link and the assumption of a Poisson-distributed outcome).

Table 4.8: Adjusted individual effects of the demographic characteristics on EQ, CR and HC

Effect (Reference)	Exploratory Questions ((EQ)	Cumulative Reasoning (CR)	Handling Conflicts (HC)	(Confidence Interval- CI)
Year of study (Year 1)	1.05	-4.13	0.31**	(0.15,0.63)
Gender (Male)	-5.66	-0.87	1.04	(0.48,2.24)
Age group (20+)	-0.78	4.10	2.88*	(1.08, 7.63)
Education level (Graduate)	-4.38	-17.10	0.19**	(0.07,0.53)
Language (Non-English)	3.80	2.92	0.56	(0.23,1.41)
Overall model	F= 1.64, p=0.179	F=0.704, p=0.625	χ^2_{LR}=30.560, p<0.001	

***p < 0.01, *p <0.05.*

As with the crude effects, there is little evidence of an association between the various predictors (demographic characteristics) and the exploratory questions (EQ) and cumulative reasoning (CR) number of utterances (all $p > 0.05$). Indeed, neither the EQ nor CR general linear was significant (both models $p > 0.05$, Table 4.8). For the number of handling conflicts (HC) utterances, the association of both year of study and education level identified at the crude level carried through to the adjusted effect. For year of study, little changed in the direction and magnitude of the incidence rate ratio (IRR_{Crude}=0.26, $IRRA_{djusted}$=0.31, $p < 0.01$, 95% CI: 0.15-0.63, as per Table 4.8), but for education level adjustment for other student characteristics (gender, age, education level and home language) substantially enhanced the level of association (IRR- $_{Crude}$=0.366, $p < 0.01$, Table 6 vs. IRR_{Crude}=0.19, $p > 0.05$, Table 4.8).

Adjustment for all of the effects did have some influence on the level and

significance of one of the other associations. Adjustment for the other student characteristics had a profound effect on the age group effect, changing both the direction and magnitude of the association. At the crude level, age was not identified as a significant predictor of handling conflicts (HC) utterances (IRR_{Crude} = 0.68, p > 0.05; Table 4.7). When differences in year of study, gender, age, education level and home language were adjusted for, a significant age effect was, however, detected with older students who had 2.88 the incidence rate relative to the younger group ($IRRA_{djusted}$=2.88, p<0.05, 95% CI: 1.08-7.63; Table 4.8).

Table 4.9 provides the estimated marginal means (co-founder adjusted) for exploratory questions (EQ) and cumulative reasoning (CR) from the multivariable models provided in Table 4.8. It should be noted that estimated marginal means could not be provided for handling conflicts (HC) utterances as these were assumed to be Poisson-distributed (see Section 4.2.1.6), and estimated marginal means from Poisson regression are not interpreted as easily, as they are small number in the sample.

Looking at the estimated marginal means in Table 4.9, it can be seen that although some effects were not significant, there were some substantial differences between the groups. For cumulative reasoning (CR), the difference between the education groups appears confounded. Non-significance between the differences identified above is more likely to be the effect of small sample size rather than the differences not being contextually important. Another way of analysing the variation between the different utterance types is by examining the composition of total utterances as represented by the individual utterance types. In Table 4.10, the average proportion of utterances of the three learning-oriented interactions (EC, CR or HC) for each of the groups and student characteristics is displayed.

Table 4.9: Estimated Marginal Means (EMMs): EQ, CR derived from the multivariable model of the adjusted effects

	Exploratory Questions (EQ)	Cumulative Reasoning (CR)
Year of study		
Year 1 (*n* = 14)	8.57	27.77
Year 2 (*n* = 24)	7.52	31.80
Gender		
Male (*n* = 16)	5.20	29.40
Female (*n* = 22)	10.86	30.27
Age group		
16-20 (*n* = 14)	8.42	27.78
20+ (*n* = 24)	7.64	31.89
Education level		
School-leavers (*n* = 20)	10.22	38.38
Graduate (*n* = 18)	5.83	21.28
Language		
English (*n* = 29)	6.13	28.37
Non-English (*n* = 9)	9.93	31.29

Table 4.10 shows that there were non-significant differences in handling conflicts (HCs) across both study years and the full range of student characteristics; however, there was a reasonable degree of variability for the other types of utterances. First year students had a higher proportion of exploratory questions (EQ) utterances than second- year students. Not surprisingly (as EQ and cumulative reasoning (CR) utterances represent a large majority of utterances), this trend was reversed for CR utterances, where second year students' were more numerous. Both age and gender appeared to be associated with the proportion of EQ utterances, with both females and students aged 16–20 years performing more of these learning-oriented utterance types (Table 4.10). Again, not surprisingly, this trend was reversed for cumulative reasoning (CR), with males and students aged above 20 years exhibiting a higher proportion of cumulative reasoning (CR) utterances. Education level (School-leavers = 0.02) and language background (Non-English = 0.02) seemed to have minimal effect on the proportion of utterances represented by particular types of exploratory questions (EQ) (Table 4.10).

Table 4.10: Average proportion of utterances of the three learning-oriented interactions (EC, CR or HC) for each of the groups and student characteristics

Effect and Levels	Exploratory questions (EQ)/ Utterances	Cumulative reasoning (CR)/ Utterances	Handling conflict (HC)/ Utterances
Year of study			
Year 1	0.23	0.77	0.03
Year 2	0.15	0.84	0.01
Group			
Y1G1	0.18	0.80	0.03
Y1G2	0.29	0.68	0.03
Y2G1	0.18	0.81	0.02
Y2G2	0.11	0.87	0.02
Y2G3	0.17	0.83	0.01
Gender			
Male	0.13	0.84	0.02
Female	0.21	0.77	0.02
Age group			
16-20	0.22	0.77	0.01
20+	0.16	0.82	0.02
Education level			
School-leavers	0.20	0.78	0.02
Graduate	0.17	0.81	0.02
Language			
English	0.18	0.80	0.02
Non-English	0.20	0.79	0.01

Y#G#=Y is year of study, G is the Group observed in that year of study.

Utterance was also considered as an aggregate measure of student participation (EQ, CR and HC combined). Two forms of this variable were considered: raw aggregate utterances, which represent a sum of the individual utterance types, and standardised utterances, where the individual utterance types are Z-transformed prior to summing. Multivariable linear models with both measures of aggregated utterance are provided in Table 4.11 shows the estimated marginal means resulting from both multivariable models and it also display the raw result representing the sum of the individual utterances from (EQ, CR and HQ) whereas the standardised measure presents the sum of Z scores (centred then scaled) individual utterance types. Crude coefficients are from bivariate linear regressions and adjusted coefficients represent the effects reported after a multivariable general linear model was fit.

Table 4.11: Learning-Oriented Utterances: Crude and adjusted effects of aggregated utterance results

	Total utterances (raw)		Total utterances (standardised)	
Effect (Reference)	**Crude**	**Adjusted**	**Crude**	**Adjusted**
Year of study (Year 2)	-1.24	1.77	-1.17	-1.00
Group (Y1G1)	F = 0.080 *p* = 0.988		F = 0.502 *p* = 0.734	
Y1G2	3.86		0.65	
Y2G1	3.43		-0.76	
Y2G2	2.93		-0.43	
Y2G3	-3.13		-1.26	
Gender (Male)	-1.97	-6.49	0.34	-0.01
Age group (20+)	16.17+	6.16	-0.87	2.70
Education level (Graduate)	-18.50*	-24.86	-1.50	-3.76
Language (Non-English)	4.46	5.87	-0.28	-0.62
		F= 0.893 *p* = 0.490		F = 1.136 *p* = 0.3619

*Y#G#=Y is year of study, G is the Group observed in that year of study. *p < 0.05.*

Table 4.12 shows the estimated marginal means resulting from both multivariable models. Estimated marginal means derived from multivariable model (presented in Table 4.11, which shows the raw and standardised measures of utterance).

Table 4.12: Estimated Marginal Means (EMMs) of utterances resulting from both multivariable models

Effect and Levels	Utterances (raw)	Utterances (standardised)
Year of study		
Year 1	37.85	0.41
Year 2	39.62	-0.59
Gender		
Male	35.49	-0.09
Female	41.98	-0.09
Age group		
16-20	33.65	-1.44
20+	41.82	1.26
Education level		
School-leavers	51.17	1.79
Graduate	26.31	-1.97
Home language		
English	35.81	0.22
Non-English	41.67	-0.40

An examination of the crude estimates for the raw aggregate utterance measure

reveals that only education level revealed a significant effect ($p < 0.05$; Table 4.11 utterance), with 18.86 minute difference in the average level of utterances between those with lower (school-leavers) and higher (graduate) education levels. It is noteworthy that when adjusted for other student characteristics, the difference between school-leavers and graduate group's utterances increased to 24.86 (51.17 minutes for the school-leavers group and 26.31 minutes for the graduate group) and the effect in the adjusted model became non-significant (Tables 4.12).

No other effect was revealed as having a statistically significant impact on either raw or standardised utterance. Indeed, both of the multivariable models displayed in Table 4.11 reveal that utterances are non-significant, however, examination of the estimated marginal means (Table 4.12) showed some important differences (*albeit* not significant). In addition to the large difference identified between the school-leavers and graduate groups (school-leavers > graduate), on average there was almost an eight minute difference (20+ > 16-20) between younger (16–20 years old) and older (20+ years old) individuals, and an approximate six minute difference between groups of different gender (females > males) and language (non-English speakers > English speakers) effects (Table 4.12).

4.3.3. Correlation of utterances with final grades

Students' grades were statistically regressed for all student characteristics. The individual and aggregated utterances and tutor individual and aggregated utterances are displayed in Table 4.13, which also includes crude associations as well as the adjusted coefficients from three multivariable models. All three models consider student characteristics but differ in how they consider student utterances. The first model considers the individual utterance scores, exploratory questions (EQ), cumulative reasoning (CR) and handling conflicts (HC). The second model considers the straight sum (raw aggregation) of the three scores in a single predictor. In the third model, the utterances are Z-transformed (centred and then scaled) prior to summing. The purpose of using the three models is to detect any possible significant differences that were not identified through the analysis each of the previous models individually. Table 4.12 shows the estimated marginal means

resulting from the first of the models. Table 4.13 illustrates crude coefficients. They are from bivariate linear regressions and adjusted coefficients represent the effects reported after a multivariable general linear model using three models: Model 1 is based on all student characteristics along with the individual utterance types (EQ, CR and HC).Model 2 considers all student characteristics and the raw aggregated utterance score is used instead of individual utterance types. Model 3 considers all student characteristics and the standardised aggregated utterances (sum of Z-transformed individual utterance types).

Table 4.13: Crude and adjusted effects of students' grades

Effect	Crude	Model 1	Model 2	Model 3
Exploratory Questions (EQ)	-0.07	-0.18		
Cumulative Reasoning (CR)	-0.07	0.07		
Handling Conflicts (HC)	0.56	0.02		
Total Utterance	0.05		0.03	
Utterance$_Z$	0.51			0.32
Tutor EQ	-0.02			
Tutor CR	0.00			
Tutor HC	0.50			
Tutor Total Utterances	-0.01			
Year of study	-4.615*	-4.72*	-4.29*	-3.92*
Group **Y1G1**	F = 1.208 p = 0.526			
Y1G2	-2.22			
Y2G1	-5.88			
Y2G2	-5.11			
Y2G3	-6.15			
Gender	-1.29	-1.47	-0.35	-0.51
Age group	-7.27***	-11.26*	-10.91*	-11.63*
Ed level	-5.51**	4.86	4.92	5.52
Language	-1.90	-1.05	-1.68	-1.33
		F = 3.11 p = 0.012	F = 3.09 p = 0.006	F = 3.79 p = 0.006

Y#G#=Y is year of study, G is the Group observed in that year of study.
****p < 0.001, **p < 0.01, *p < 0.05.*

The three multivariable models were significantly different overall (all $p < 0.05$); however, there is no evidence that either student or tutor utterance scores influenced students' grades (Table 4.13). All coefficients for the utterance variables were non-significant regardless of whether they were considered individually or aggregated or whether coefficients were crude or adjusted. Some of the other student characteristics were associated with students' grade. Both crude and adjusted estimates of the year of study (first year, second year) and age groups (16–20 year,

20+ years) were significant (all $p < 0.05$). The estimates of the school-leavers could be shown to be significant at the crude level but not when there was adjustment for other predictors. The most probable confounder is likely to be age, as the more educated students are, the older they are likely to be. Table 4.14 shows the estimated marginal means (EMMS) of student grades derived from multivariable Model 1 (that involved individual utterance types presented).

Table 4.14: Estimated Marginal Means (EMMs) of students' grades

Effect and Levels	**Final Grades**
Year of study	
Year 1 (*n* = 14)	74.59
Year 2 (*n* = 24)	69.87*
Gender	
Male (*n* = 16)	71.49
Female (*n* = 22)	72.97
Age group	
16-20 (*n* = 14)	77.86
20+ (*n* = 24)	66.60*
Education level	
School-leavers (*n* = 20)	69.80
Graduate (n = 18)	74.66
Language	
English (*n* = 29)	72.75
Non-English (*n* = 9)	71.70

**p<0.05.*

The estimated marginal means in Table 4.14 illustrates that, on average, first year students scored higher than second year students. There was a large difference in the grades obtained by younger and older students, with younger students on average attaining a score 11 units higher (77.86-66.60).

4.3.4. Results summary

There were no significant differences between groups engaging critically but constructively with each other's ideas by asking higher order questions (EQ) or by providing and considering alternative explanations and building positively but uncritically on what is said by its group members, which might lead to automatic consensus and group members constructing a "common knowledge" by accumulation (CR). The non-significant result detected was due to the small sample size (low power) (Table 4.9).

Although, females and students aged 16-20 years scored higher in the EQ learning-oriented utterance type (females = 0.21 vs. males = 0.16; 16-20 =0.22 vs. 20+ = 0.16) (Table 4.10), non-significant differences were detected. Interestingly, with differences in year of study, gender, age, education level and home language adjusted for, when group members acknowledge and discuss contradictory information – characterised by expressing disagreement, negation of previous utterances and/or counter arguments in handling conflicts (HC) and learning-oriented utterances – a statistically significant age effect was detected. In this way, students aged above 20 years had 2.88 the incidence of the HC learning-oriented utterances relative to the students aged 16-20 years old (Table 4.8). Education level groups showed some differences for cumulative reasoning (CR) but the variations detected cannot be guaranteed as the education level effect is mostly confounded by age in that graduate students are mostly older than 20 years. While the first year students demonstrated a considerably higher proportion of exploratory question (EQ) learning-oriented utterances compared with second year students (0.23 and 0.15, respectively), a reverse, but non-significant effect was found for cumulative reasoning (CR) learning-oriented utterances, where second year students scored higher than first year students (0.84 and 0.77, respectively) (Table 4.10).

There was little evidence of an association between the aggregated student and tutor total learning-oriented utterances (Table 4.6). When examining the correlation between student and tutor utterances, a weak association was detected in magnitude and direction. There appears to be a weak negative association between student and tutor exploratory questions (EQ) learning-oriented utterances (Table 4.6). Moreover, it appeared that there is a weak positive association between student and tutor cumulative reasoning (CR) learning-oriented utterances (Table 4.6). Furthermore, there was a weak positive association between student and tutor handling conflicts (HC) learning- oriented utterances (Table 4.6). While the examination of the estimated marginal means of the raw and standardised measures of utterance suggests some important differences (*albeit* not significant) − (Table 4.12), there was no evidence that either student or tutor utterance results influenced students' final grade (Table 4.13).

In this part of the study, there were few statistically proven effects of the characteristics of learners on learning in a small group using the PBL process. While in the current study, students' verbal contributions were affected clinically by tutor utterances, non- significant effects were also determined. On examining the data for different PBL groups, some differences, *albeit* not significant, were noted. Based on to the findings of the current study, it is possible to argue that there is an association between the students' critical higher order thinking engagement and the construction of prior knowledge and the tutor interaction and tutoring style. Students devoted most of the session time to two of the utterance learning tasks: exploratory questioning and cumulative reasoning. While PBL does underpin higher order constructive thinking and other cognitive reasoning skills and learning-oriented tasks, notably, some groups of first year students devoted the session time towards the cumulative reasoning-oriented tasks rather than the exploratory questions learning- oriented utterances. Cumulative reasoning learning-oriented utterances occurred throughout the session time. Resolving conflicts was observed rarely to occur among these groups and there was a negative correlation between students' exploratory questioning learning-oriented interactions and tutors' utterances.

The outcomes revealed that content expert tutors tend to use their subject matter expertise more to direct the discussion in the tutorial group. Handling conflicts and contradictory knowledge utterances were not encountered and the students devoted most of the session time towards the other two learning-oriented tasks, exploratory questions and cumulative reasoning. While PBL is known to induce cognitive conflict within students, leading them to conceptual change or a restructuring of their knowledge base (De Grave *et al*., 1996), since conflicts rarely occurred, they did not need to be handled in the first year groups of the study. Some students, especially first year students and those without prior tertiary education experience, seemed to be hesitant and anxious about contributing to the discussion. This could be attributed to the predominant contribution of the graduate students or those who already have a degree being dominant and forcing their knowledge on the group discussion. A content and process expert tutor who provides most of the general argument and intervenes in most of the session time could be another factor.

4.4. Discussion

4.4.1. Overview

According to Remedios and colleagues (2008a), only limited commentary has described how students interact in the collaborative process or how students view the restraints of performance. PBL students are assumed to be more able to learn information because the PBL environment encourages the activation of prior knowledge and the elaboration of newly acquired knowledge. There were few statistical significant differences detected between the observed demographic groups in this study. Few differences were detected as having a statistical effect. The non-significance detected was mostly due to the small sample size (low power). The descriptive analysis through the field notes attained form comprehensive scenery of students' results. Cumulative reasoning skills are developed and practiced during PBL and there has been considerable support for further research into measurements of clinical reasoning that focuses much more on the process and less on the diagnostic outcome (Elstein & Schwartz, 2000; Newble *et al*., 2000).

In this part of the research, students' learning-oriented utterances were recorded to explore the influence of their demographics on their verbal interaction, to investigate the association between student utterances and tutor utterances and to detect the relationship between students' verbal interaction and final grades in order to answer the research questions and to test the proposed hypotheses.

4.4.2. Gender and participation

Research Question 3 asked whether gender influenced student utterances in PBL tutorials. It was hypothesized that there will be a difference between the learning-oriented utterances of the male and female students. The results, however, showed that there was a no significant difference between male and female students in the three types of learning-oriented utterances. Females in particular showed more initiative in identifying learning needs and exploring new knowledge in PBL than did males. This finding is similar to what is reported in the literature, which states that females are generally co-operative learners in that they tend to care about group

members and engage with group activities rather than taking a more forceful stand (Reynolds, 2003). Although female students were noted to retrieve new information relevant to the PBL problem by asking more explanatory questions compared to their male colleagues, this was not statistically significant. This contradicts findings in literature, which state that males have a different approach (described as "the masculine approach") to achieving tasks that is forceful, structured and logical (Broverman *et al*., 1972; McLaughlin *et al*., 1981). Additionally, male students showed more initiative than females in the cumulative reasoning learning-oriented utterances, which again is contradictory to the reported findings in the literature in which males are expected to be less attuned to the socio-emotional aspects of human relationships and more concerned with task achievement and outcomes (Kim & Bresnahan, 1996). Although females asked more questions and engaged more critically to obtain information relevant to the case, some studies have indicated that women do not always have a voice in class (Belenky *et al*., 1986; Gawelek *et al*., 1994) and are often reticent to ask questions (Kim & Bresnahan, 1996). In the current study, males scored higher in cumulative reasoning learning-oriented utterances than females. This supports the results of Alduos and colleagues' study, (1997) that shows that male applicants scored more highly on the Graduate American Medical School Admissions Test in reasoning skills in humanities and sciences than female medical students. From the field notes during the present study, male students in both years of study presented conclusive arguments and drew conclusions relevant to the case and from the information discussed in the group more often than did females. Similarly, males demonstrated deductive thinking more so than females in Vermunt's (2005) observational study. Although group members rarely acknowledge or did not acknowledge or discuss contradictory information, females did perform in this criterion as well as males in both year levels. Both males and females behaved similarly when observed handling contradictory ideas and knowledge in the current study, while only females were found to express more trust in the quality of ideas provided by their peers (Reynolds, 2003). Other research has found that in PBL, males and females are relatively similar in their self-perceptions of preferred conversational styles across cultures and apply these styles (Kim & Bresnahan, 1996). In the literature, differences were mostly anticipated between males and females' verbal interaction during PBL tutorials while in the current

study, no significant differences were recorded in this regard.

4.4.3. Age and participation

Research Question 3 asked whether age influenced student participation during PBL tutorials. It was hypothesized that there would be a difference between the learning-oriented utterances of younger students (16-20 years old) and older students (20+ years old) Results, however, showed that there was no significant difference between male and female students in the three types of learning-oriented utterances.

In the present study, younger students showed significantly more initiative in identifying learning issues by engaging constructively and using their metacognition skills than did the older students, which is different from Miflin and colleagues' (2003) study, in which younger students were less likely than older students to perceive the long-term aims and purposes of PBL. Students aged 16 to 20 years of age were noted to be attempting to deconstruct information into segments, testing these segments through alternative arguments and trying to relate them to the problem more than the other age group. Mature-aged students perform better overall than younger-aged students in the cumulative learning- oriented utterances and they have a positive influence on the course, with their tutorial contributions considerably better than that of the younger-aged students. These findings support the literature (Boon, 1980).

Older students (20+ years old) in the current study were involved in building positively on the thinking of their peers and engaging critically to the group discussion, which is contrary to the findings of several studies that found that older students did less well in presenting reasoned hypotheses in sciences (Aldous *et al*., 1997; Kay *et al*., 2002). This difference could be attributed to the additional experience of older students have and because their reasoning skills are mature enough to build and draw conclusions. In this research, students aged 16 to 20 years scored higher for the exploratory questioning (EQ) learning-oriented utterance type, in contrast to the research of Elizabeth Aldred (1997) who found that mature-aged students engaged in and benefitted more from the PBL approach than from traditional learning. On the other hand, older students in the current study affirmed

the literature and were observed to engage to a higher degree in the cumulative reasoning learning-oriented tasks. Younger students in the first year group were more active in asking questions than older students, which supports the literature that states that in small group settings such as PBL, young students are motivated to inquire about the problem at hand.

4.4.4. Prior education and years of study impact on participation

Research Question 3 asked whether education level influenced student participation during PBL tutorials. It was hypothesized that there would be a difference in learning- oriented utterances between school-leavers and graduate students and first year and second year students, however, the results showed that there was a non-significant difference between these groups of students in the three types of learning-oriented utterances: EQ, CR and HC.

The most likely confounder found in the results of students' aggregated utterances was age, where graduate students were likely to be older. This finding was in line with the literature that states that graduate students bring distinct qualities to a course that relate to a student's age (Wilkinson *et al*., 2004). On examining students' educational background, first year students demonstrated more initiative in identifying learning needs than second year students, which is in contradiction with the study that found that they put considerable pressure on the other members of the group to help them to achieve their goals (Miflin *et al*, 2003). An opposing scenario was observed in terms of second year students' cumulative reasoning learning-oriented utterances, which was higher relatively. This supports the notion that the learning of new concepts through problem-solving in PBL fosters the development of reasoning strategies (Yeung *et al*., 1999).

Being in their second year means that the students have better developed their cognitive skills and are more experienced in exploring the knowledge required for the case in hand. Another empirical study that examined the reasoning process showed that PBL students utilised "backward learning" (a hypothetico-deductive mode of reasoning) to a greater extent than did students from a conventional curriculum (Patel *et al*., 1991). In the present study, first year students engaged

more critically but constructively with each other's ideas by asking higher order questions more than second year students did, in contradiction to the findings of Singaram *et al*., (2008), where there was no significant association between prior educational training experience and group effectiveness. In this study, the eagerness of first year students to adopt the PBL methodology might lead and motivate them towards inquiring more about the cases in hand and encourage them to become significant contributors to the group discussions. Second year students, however, might have developed further in their learning style and, since they are already acquainted with the PBL process, they may be inclined to rely on their peers' learning activities.

In the present study, graduate students and older students (20+ years of age) had similar results, as most graduates are above 20 years of age. Higher education levels and older students were observed to have presented well organised information relevant to the case more frequently than the first year groups. This could be attributed to the maturity of students in the program and the more experience they had in researching and organising information to suit the case, whereas younger students tend to be more active learners and to search for information using their exploratory questioning skills and the available sources to attain more information in the current study. First year students performed at a higher level than second year students in identifying information relevant to the case where they used the strategy of relating and structuring, which contradicts findings in the literature (Vermunt, 2005). The familiarity of second year medical students to the PBL process might, however, have enabled them to be in control of their cumulative reasoning strategies in the current study. In order to achieve the three common goals of PBL tutorials - collaborative learning, problem-solving skills and achieving individual learning needs - members in the group are obliged to share their knowledge, reasoning and research (Kelson & Distlehorst, 2000; Azer, 2001). As students' experience with PBL grows, they realise that the role of the tutor in the PBL tutorial is that of a facilitator rather than teacher. Accordingly, the results of the present study showed that students in their second year from all education levels depended on the tutor less than they did in their first year.

4.4.5. Language background and participation

Research Question 3 asked whether language spoken at home influenced student participation during PBL tutorials. It was hypothesized that there would be a difference between English first language students and non-English first language students' learning- oriented utterances. The results, however, showed that there was no significant difference between English first language students and non-English first language students in the three types of learning-oriented utterances.

Students of different language backgrounds in the present study demonstrated differently when contributing to the group discussion. It must be acknowledged that communicating in a second language may make public displays of knowledge and identifying learning needs more challenging for these students than for those verbalising in their first language (Remedios *et al*., 2008b), but over time, confidence builds. Although language barriers could be considered as an obstacle in achieving skills in PBL, students with English as a first language demonstrated lower levels of the learning-oriented activities than students with a non-English first language in exploring new knowledge in the present study.

There was a proportionally small number of non-English home language students in comparison with English home language students in the observed tutorials of the present study; however, the small number of non-English students' engagement using their learning-oriented utterances were observed to be more confident and proactive in exploring new knowledge in their second year than in first year. This was supported by the literature, which states it is important to consider how group processes in PBL accommodate the impact of diversity and culture on creativity in exploring new knowledge (Suebnukarn & Haddawy, 2006). Non-English students were observed to utilise their deductive higher order thinking to analyse the case in hand and find connections between segments. This finding contradicts Marjanovic's (1997) conclusions, which indicates that international students experience more problems in PBL learning tasks due to language difficulties and cultural and educational background than English-speaking students. In both years of study, non-English students sought clarification for facts and hidden concepts and unidentified

terms in order to participate in the process of group discussion in PBL, which supports the principle that in PBL, understanding the terms and the involvement in learning- oriented inquiry utterances is vital for the success of group discussion (Edens, 2000).

The non-English home language students in this study performed highly and positively in the group discussion, especially those with graduate or medical degrees. This contradicts the notion that cultural and language factors have a role in challenging students' participation and collaboration in tutorials (Zhang, 2010). The results suggest that the more prior knowledge the non-English group of students had and were able to retrieve, the more proactive and engaged in the PBL learning activities they were. Likewise, it was noted that non-English students tried to clarify concepts and undefined terms and hidden facts with their peers more than did the English home language students. This might be because non-English students are speakers of a second language and need support to understand complex concepts in English. Furthermore, non-English students showed a greater tendency to work collaboratively within the group to acquire knowledge, which was detected through the increased proportions of the learning- oriented utterances shown by this group. These findings are in contrast to Khoo's (2003) findings, where it is stated non-English students prefer to listen more to didactic teaching and to learn in a quiet or silent environment (Khoo, 2003). This finding also contradicts the belief that some students from different cultural backgrounds are shy and often inexperienced in mixing with other cultures, thus making them less willing to engage in collaborative group work (Bressan, 2005). Although diversity can increase the range of knowledge and skills available to the group and stimulate divergent thinking, the personal reticence of non-English students can inhibit effective communication and decrease interaction within group learning (Nijstad *et al*., 2003). Remarkably, as measured by their exploratory questioning learning-oriented utterances in the learning-oriented tasks, non-English students engaged constructively and critically more than English home language students.

A lack of language skills appeared not to be an impediment for students whose first language was not English, as these students asked more questions and

engaged critically and more constructively in the group interaction than English-speaking students. This is similar to the findings of Gill and colleagues (2004), who state that that the majority of students with English as their second language did not identify language difficulty as a barrier to participating or asking critical question, There was an occasion in this study, however, where a non-English student struggled to pronounce certain terms that she tried to use in her exploratory questions and the tutor corrected her pronunciation, thus adding to her knowledge. Interestingly, non-English students with higher levels of education, such as holding a medical or health sciences degree, engaged positively and effectively in the verbal interaction and their peers considered them as a trustworthy knowledge resource despite their differences in cultural background.

Wun (2007) compared Hong Kong medical students' participation in small group tutorials in PBL and non-PBL curricula Hong Kong. He concluded that PBL, when it starts in the early years of a medical curriculum, can be associated with more active student participation, interaction and collaboration in small group tutorials. This conclusion is supportive of the concept that PBL enhances the students'" cognitive thinking skills, including critical thinking, in a collaborative group context or team environment regardless of the language spoken at home, as shown with the non-English students in this current study.

4.4.6. Influence of tutor intervention on student learning-oriented utterances

Research Question 4 asked whether tutor intervention during the PBL tutorials affects or influences students' participation and it was hypothesized that tutor intervention would have an influence on students' participation. Congruently, the results showed that there was weak association detected in magnitude and direction between the student participation and tutor intervention in the three types of learning-oriented Utterances.

With its emphasis on learning through problem-solving and on making key aspects of expertise visible, PBL exemplifies the cognitive apprenticeship model (Collins *et al*., 1989). In PBL, the teacher/facilitator is an expert learner, able to model good strategies for learning and thinking, rather than an expert in the content itself. The

facilitator scaffolds student learning through modelling and coaching, primarily through the use of questioning strategies (Hmelo-Silver & Barrows, 2003). Facilitators progressively fade their scaffolding as students become more experienced with PBL, until finally the learners adopt many of the facilitator's roles. The facilitator is responsible both for moving the students through the various stages of PBL and for monitoring the group's process. This monitoring assures that all students are involved and encourages them both to externalise their own thinking and to comment on each other's thinking (Hmelo-Silver, 2002; Koschmann *et al*., 1994). The PBL facilitator therefore guides the development of higher order thinking skills by encouraging students to justify their thinking and externalises self-reflection by directing appropriate questions to individuals.

The association between the tutors' and students' learning-oriented utterances was both positively and weakly detected in particular types of learning tasks. These results showed that the more the content-expert tutor of the current study guided and stimulated the metacognition of the students, the more the cognitive and uncritical thinking skills of the students diminished. This is contradictory to the literature findings where the intervention of the tutor affected the students' cognitive skills positively (Hughes & Lucas, 1997). It was noticed that in one of the second year groups, the facilitator established ground rules and allocated certain tasks to each student, which enabled the students to contribute to the discussion significantly and equally and allowed the tutor to perform more of his/her duties. Azer's (2011) study supports this notion by recommending tutors to establish ground rules in the tutorials from the commencement of the PBL tutorials to avoid any conflicts and to encourage the positive contributions of group members. The results of this study support the literature, which states that a tutor should both know how to deal with the subject matter expertise and should know how to facilitate the learning process (Dolmans *et al*., 2002). Contrary to the initial hypothesis, the results demonstrated that tutor's interpersonal behaviour and stimulation of contextual learning did not significantly contribute to better group functioning or have an impact on student grades in magnitude or direction.

An association was drawn between the students' perceptions toward tutor practice

(Part A) and the type of the tutor intervention in the recorded PBL tutorials (Part B) in that while a positive perception towards the tutor's facilitation qualities was found particularly among first year students, it was noticed to affect their verbal interaction negatively, i.e. inhibited their learning-oriented utterances. The second year students perceived the tutor practice less positively than the first year students and this was also observed with the more direct tutor facilitation style of one of the second year groups, where the tutor maintained a traditional teacher role rather than a facilitator role by presenting general and conclusive arguments. The tutors' style in the other two second year groups was more facilitatory.

There are several important issues in understanding how to facilitate and why it is so difficult for a facilitator who is comfortable with one group and a small number of students to then monitor a typical classroom with several groups and many students. Facilitation is a subtle skill. It involves knowing when an appropriate question is called for, when the students are going off-track and when the PBL process is stalled. In a study of an expert PBL facilitator, Hmelo-Silver (2002) found that this facilitator accomplished his role largely through metacognitive questioning and questioning that focused students' attention and elicited causal explanations. From this, she concluded that an expert facilitator must have a flexible set of strategies that can be tailored to different stages of the PBL process.

4.4.7. The correlation between participation and end of year assessments results

Research Question 5 asked whether there was an association between the students' participation during PBL tutorials and their academic achievement, testing the hypotheses of no association between these variables. The results showed that there was no evidence of any association to any of the types of the learning-oriented utterances.

It was presumed that students who actively contributed to achieving the group tasks would be successful in their academic tests; however, there was no evidence in the results of the current study to suggest that either student or tutor learning-oriented utterance results influenced the student's end of year grades. Hidi and Renninger (2006) suggest that academic achievement is positively affected by situational

interest of students. On the other hand, van den Hurk, *et al*., (2001) claim that there is a strong link between the depth of discussion and course grades. Again, it is reiterated that the assessment is based on students' academic performance during the traditional basic sciences lectures rather than the students' performance and application of the learning-oriented tasks during PBL tutorials, so the link between those two variables could not be established.

It was found in the literature that students who are active in the PBL tutorial achieve better academically because they have a more engaged and motivated attitude towards their education and as a consequence invest more into their education (Imafuku, 2007). These results of Imafuku's (2007) study suggest that there is a causal relationship between a student's contributions to the tutorial group process and academic achievement. In some studies in the literature, higher achievement in students' academics was measured through feedback and self-assessment (Zimmerman, 1990; Eva *et al*., 2004); however, in this research no clear link can be established between the students' performance in PBL and the summative assessment.

On average, first year students recorded higher end of year (phase) assessment grades than second year students, which was contradictory to the notion that mature-aged medical students achieve better in their overall assessment compared with their younger counterparts or first year students (Rolfe *et al*., 1995). Again, it is important to note that the assessment used to evaluate the students' academic performance is for the didactic type of basic and scientific written subjects rather than the effectiveness of students in PBL courses.

4.4.8. Analysis of the descriptive field notes of the Day 1 PBL process

PBL at the MBBS program at Bond University is structured so that students are exposed to a new problem (case) on Day 1. The case is presented to them with minimum information and, from this, they should be able to explain their understanding to the problem triggers. In this research, first year group members engaged critically but constructively with each other's ideas by asking higher order questions that were relevant for obtaining a good understanding of the subject more

than the second year students did. Higher order thinking draws on the logical process of induction (observing and testing) and requires deduction so that inferences about cause and effect can be tested formally as hypothesis; however, with the first year students the higher order thinking that lead to the critical questions being formed was directed mostly to their tutor, as noticed in the videotaped sessions. Moreover, the first year groups' statistical analysis showed that they adopted the exploratory question learning-oriented utterances more than the second year students. Qualitatively, however, and from a PBL learning perspective, the second year group adopted more valuable and purposeful PBL activities where the exploratory questions were directed to the tutor and to other students. Only elaboration but not collaboration was observed through the types of learning-oriented utterances used by the first year students. Two major factors could be the cause of the first year students' type of cognitive thinking activities and their inability or unwillingness to think collaboratively: the effect of dominant students and the tutor facilitation style. All of the first year groups had dominant students in them who occupied most of the session learning time, forcing their knowledge to dominate the group discussion and depriving other students from effectively participating in the learning-oriented tasks. Hendry *et al*. (2003) argues that managing the balance between quiet and dominant participating students is important in a successful tutorial. Moreover, the students - especially in the first year groups – might not be able to use their lateral, critical or problem-solving skills appropriately, as their collaborative thinking skills might not be developed and the metacognitive abilities could not be practiced efficiently through these deficient group discussions. Furthermore, first year students and those of the lower education level might become reluctant to present general arguments and hesitant and anxious to contribute to the discussion as their information might be diminished, deceived and contradicted by the more knowledgeable and dominating students. Some of those students tended to verify their answers through the dominant students but not the tutor. The development of these cognitive thinking skills through PBL sessions is crucial to yield PBL future thinkers and independent learners. It was noticed that all of the dominant students are graduate students and one of them holds a medical degree. Students in their group considered them a trustworthy resource of knowledge and directed most of their questions toward them rather than the tutor. A skilful tutor should control the

discussion process and motivate the significant contribution of the students. The facilitator could have stimulated the other group members to explain or clarify the presented ideas or thoughts and should have selected mainly the quiet and withdrawn students for that task. The tutor in one of the first year groups advised the dominant student in the class to allow his peers to contribute to the discussion, thus allowing the other group members to use their brainstorming and cognitive thinking skills. If the tutor had not done this, the presence of the dominant student might have meant that the other members of the group would not to fill the gap in their knowledge, as they were presented mostly with conclusive arguments that did not allow them to go through the problem solving and critical thinking process that should happen at this stage of the PBL process. While first year students could not maintain the proper group functionality and required more tutor facilitation, most of the second year groups were more organised and more productive in their group process. The second year groups operated differently to first- year groups by utilising factors that enhanced the adoption of learning-oriented tasks. These factors were a tutor-directed facilitation style, the establishment of ground rules by the facilitator and the mutual contribution of the group members. When facilitators support the learning and effective collaborative process, this can lead to knowledge construction as students can construct joint explanations. An analysis of two PBL tutorial sessions found that student discourse often focused on responding to and refining ideas that had been proposed, which supports the literature (Hmelo-Silver, 2002). Most of the students in the second year groups built critically but constructively on what was said by other group members. This logical extension of cumulative thinking utterances reflected reasoning and echoed a critical way of thinking. It was also noticed that second year students used their lateral and collaborative thinking, which allowed them to present more general arguments and draw conclusions from the discussed information. Reflecting on the relationship between problem solving and learning is a critical component of PBL and is needed to support the construction of extensive and flexible knowledge (Salomon & Perkins, 1989). This reflection should help learners understand the relationship between their learning and problem-solving goals. Thus, each problem-solving task is not an end in itself but rather a means to achieve a self-defined learning goal (Bereiter & Scardamalia, 1989).

Only one group of second year students had a tutor who adopted a directive facilitation where they maintained the teacher role and provided the general arguments. Students in this group tended to depend more on this tutor for guidance and the reinforcement of their responses, especially the ones lacking prior knowledge or students who were unable to motivate their reasoning thinking properly. This situation was evident when the students failed to provide a conclusive summary of the case at the end of the session and instead waited for the tutor to provide the answer.

There were very few conflicts regarding information in the first year groups of the study. Yet again, this could be attributed to the dominant students' contribution as other members of the group might be reluctant to present any information or arguments that might by diminished or thought mistaken. On the other hand, most of the second- year student groups acknowledged and discussed contradictory information, expressed their disagreement and negation of previous utterances and/or counter-arguments was also conveyed. These discussions were critical yet constructive. Sometimes, existing knowledge contradicts new information and students can react in many different ways to such a situation, varying from not believing the new information to a radical change of thinking (Chinn & Brewer, 1993). Brown and Palincsar (1989) indicate that recognising and elaborating conflicts positively influences learning. When students recognise contradictions between their own and the group members' perspectives, they might be stimulated to generate explanations, justifications and reflections and to search for new information.

4.5. Conclusions

This chapter described Part B of this study: an observational investigation which examines the effect of student demographics (gender, age, learning experience and home language) on the PBL learning experience, focusing on the students' verbal interaction through the measurement of their learning-oriented utterances by adopting an observational instrument. The participants/sample size, the development and validation of the instruments used in this aspect of the study and the findings of

the analysis from videotaping five PBL tutorial sessions were all presented and discussed and analysed. Additionally, the correlational association between the learning-oriented utterances of the students and phases of the end of year assessment based on their demographic characteristics were described and analysed.

In summary, the different effects detected between examined demographics were non- significant due to the small sample size except for the age factor. While the first year students and females demonstrated a considerably higher proportion of exploratory questioning (EQ) learning-oriented utterances compared with second year students and male students, the first year students scored lower proportions for cumulative reasoning (CR) learning-oriented utterances than second year students but non-significant effect was found. The only significant effect was found in students aged above 20 years results relative to the students aged 16-20 years old when expressing disagreement, negation of previous utterances and/or counter arguments in handling conflicts (HC) learning-oriented utterances.

When examining the correlation between student and tutor utterances, a weak association was detected in magnitude and direction. A weak negative association between student and tutor exploratory questions (EQ) learning-oriented utterances was found and it appeared that there is a weak positive association between student and tutor cumulative reasoning (CR) learning-oriented utterances. Furthermore, there was a weak positive association between student and tutor handling conflicts (HC) learning-oriented utterances. There was no evidence that either student or tutor utterance results influenced the students' final grade. Chapter 5 will present the overall conclusion of the findings, the limitations of this study and recommendations for further work.

CHAPTER 5

SYNTHESIS

5.1. Introduction

This study was set out with two purposes. The first was to explore whether demographics influence students' attitudes toward the problem-based learning (PBL) process and secondly, to investigate the impact of students' demographics on their verbal interaction in PBL tutorials. It also aimed to examine the correlation between students' verbal interaction and their end of year grades. This Chapter presents a summary of the research, focusing on the findings and their implications before outlining the limitations of the research and avenues for further work.

In order to attain the goals of this study, five research questions were formulated. Two questions were allocated to the first part of the study (Part A) where a questionnaire instrument was used to collect the data that was analysed and discussed in Chapter 3. Three research questions were designed to answer the queries found in the second part of the study (Part B), where a validated learning-oriented utterance instrument in conjunction with a document review process were used to collect the data needed to answer these research questions. Additionally, the data collected in Part B were analysed and discussed in Chapter 4.

5.1.1. Part A

The following two research questions that were formulated for the first part of the study (Part A):

- Research Question 1 (RQ1): Do gender, age, education background and home language affect students' perceptions of PBL based on the four subscales: skills development (SD), group process (GP), learning preference (LP) and tutor practice (TP)?
- Research Question 2 (RQ2): Does the students' perception of PBL change as they progress through their studies (as measured in the students' first, second and third years of study) with consideration of the four demographic characteristics?

It was hypothesized in this research that students with different demographics or from different educational or cultural backgrounds would perceive PBL differently,

but no evidence to support this hypothesis was found in the results of this study. PBL was highly supported and accepted as a learning experience by all students, irrespective of their age, stage of education, gender and first language as measured by the questionnaire. The results of this research shows that PBL as a learning methodology can minimise any constraints for students that might be related to demographics, therefore allowing students to articulate themselves to their full benefit during his or her learning process.

The preference of students for PBL rather than lectures is believed to be due to several factors: ability to contribute, interact, experience and develop their thinking skills in the relatively safe environment of a small group. The results of both the cross-sectional and longitudinal approaches in Part A of the study suggests that PBL might be best used in the early stages of any degree course to acquire the foundational factual knowledge that can be applied to any practical problem encountered in the later years in conjunction with the traditional didactic teaching.

The results of this research show that PBL was perceived more positively and in a distinguishable way by younger learners (16-20 years) than older ones (20+ years) and also by first year students in comparison to students from other years of the course. This finding could be attributed to the student's enthusiasm toward PBL as a newly discovered learning approach that enables them to be self-determining and self-directed learners and enhance their cognitive thinking. It also shows that although PBL was designed to accommodate to the needs of graduate students (Taylor & Miflin, 2008), it appears to meet the needs of school-leavers. Interestingly, one factor that was continually and significantly detected to have an effect through all stages of development as shown in the analysis of the questionnaire instrument results and the observation measurement instrument result (Part B) was the maturity factor. The age factor confounded by education level factor or the year of study was detected to display a marked difference between the different groups of the study with younger age students showing more support to most of the PBL aspects.

The other two demographics examined in this study (gender and home

language) were anticipated to have an effect on the students' perception of PBL. Surprisingly, the effect of these two demographic factors was non-existent. Though, from the literature review (Chapters 2 and 3), it was believed that the different conversational styles of each gender would influence the students' perception or participation, the effect was not detected in these results. Language as a reflection for culture was another factor that was presumed to have a substantial effect on student functionality, particularly when the spoken language was not English. Students from non-English language backgrounds reported a positive attitude towards PBL. The positive attitude adopted by these students toward the small group environment could be attributed to a number of factors. The PBL environment may encourage and allow them to interact more actively in tutorials than other learning environments do, as well as focus on the development of their thinking skills and the interchange of knowledge. The small group size and encouraging environment might also allow them to overcome the any hurdles due to cultural difference they might have.

5.1.2. Part B

To investigate the influence of demographics on students' verbal interaction and academic achievement the following research questions were designed:

- Research Question 3 (RQ3): Do gender, age, educational background and home language influence student utterances during PBL tutorials?
- Research Question 4 (RQ4): Does tutor intervention during the PBL tutorials affect or influence students' utterances?
- Research Question 5 (RQ5): Is there an association between the students' utterances during PBL tutorials and their academic achievement?

The research project involved intense observation of the videotaped sessions of the five student groups during their Day 1 of PBL tutorials for one week. One notable finding from this study is that while PBL was designed as for graduate medical students, first year students and school-leavers were stronger advocates of PBL than older and graduates. Younger and first year students may have correlated their student-centred characteristics with their facilitator directions in order to enhance

their cognitive thinking skills and utilise their accumulated expertise from their own study and research in PBL. Younger learners perceived PBL positively as they regarded PBL approach as a resourceful method of individuality, especially in terms of their learning scope and cognitive skills development.

With younger students and those who have a lower educational background, reluctance to present general arguments, hesitancy and anxiousness might lead an inability to efficiently engage their higher order cognitive lateral, critical or problem-solving skills (usually applied in Day 1 of the Bond University PBL process; Figure 1.2). The negative effect from this might lead to negative outcomes, such as the student being a passive learner and dependent thinker, however, as with the second year groups, if tutorial ground rules, an efficient facilitation style and reflection time are implemented, it can result in more effective collaborative learning and therefore help to construct joint flexible knowledge that enhances the adoption of learning-oriented tasks.

PBL and small group work are means by which students can be encouraged to learn the crucial skills of working effectively in teams and developing a professional approach to their work. Group study requires students to articulate what they know to fellow group members. Teamwork and a collaborative rather than competitive learning environment is highly encouraged in the PBL process, where the faculty facilitator and the group of students ideally develop a level of respect for each other's thoughts and ideas. When students use problem-solving and critical learning in PBL, they are expected to correlate their student-centred characteristics and their facilitator directions in order to utilise their knowledge and accumulated expertise from their own study and prior knowledge. The results of this study show that this process can be altered by the presence of the dominating student or if the tutor adopts a teacher-directed rather than facilitating role.

The realisation that the tutor's role in a PBL tutorial was that of a facilitator rather than a teacher was integral to the students' growing PBL experience. This process was evident in mature and highly educated students who had less dependence on tutor facilitation than younger students or students with less education. The tutorial

functionality was minimally impacted by the tutor's facilitation style. One role of a tutor is to intervene in order to accelerate the tutorial process and to accomplish the required learning objectives, especially with students with low levels of prior knowledge.

It was hypothesized that students who actively contributed to achieving group tasks would be successful in their academic tests. While the correlation between the students and tutor-learning-oriented utterances was found to be positively (in cumulative reasoning (CR) and handling conflicts (HC)) and negatively (in exploratory questions (EQ)) weak in some of the learning-oriented tasks, no influence of either student nor tutor-learning-oriented utterance results on the student end of year (phase) assessment grades was found. This is contradictory to some of the findings reported in the literature (Chapter 2 and 4), which noted the impact of the students' participation on their academic achievement. It was, however, consistent with the studies in the literature that show no relevance between these two variables.

Watching the contextual involvement (Field notes) and tutor intervention in the PBL tutorial process of the videotaped PBL sessions under investigation in the present study revealed that that tutors who are content experts can have both a positive and negative influence on a student's contribution. The student might be motivated positively to contribute to the discussion and thus will engage more critically and constructively and use her or his higher order thinking and build on her or his prior knowledge and peers' ideas and thoughts. Alternately, their metacognition skills might be altered negatively in that they will form an inclination habit towards the tutor to direct the learning and will be using only their cognitive skills divergently but not convergently. This second process will not yield the desired PBL outcome of creating independent learners and thinkers.

While the final grades of the students were initially conceived of as a measurement tool that might provide an insight into the students' performance in the PBL groups, they could not be utilised as an assessment tool to measure the student verbal interaction. The paper and pencil exams were used to evaluate the students'

academic achievement during the traditional basic science lectures; therefore, they could not be used as indicative results of the quality of the students' learning-oriented utterances or cognitive engagement during PBL tutorials.

Although constructive learning styles such as PBL show relative association with learning outcomes (Wigen *et al*., 2003), the end of year (phase) results cannot be applied to the results of this study, as the video recordings were conducted in the sixth week of the semester and students' performances might have changed before the end of year testing, specifically with students of lower education level and non-English students. The readiness of the students to contribute during small group sessions does not reflect a directly personal commitment to studying or the quality of learning (Nieminen *et al*., 2006). Congruently, verbal interaction is an essential construct of the PBL tutorials. The utterances of the students and the tutor can be interrelated both negatively and positively. The facilitator who adopts an ideal facilitation style will affect resolutely on the students' verbal interaction, while if the tutor adopt a teacher-directed facilitation style she or he will affect the students' ability to develop the appropriate cognitive thinking skills and will not be able to engage significantly into the group discussion. Even when a negative association is found, however, the overall effect of the facilitator on the group was found to be affirmative.

While tutors in the current study were both content and process experts, they both had a tendency to use their subject matter expertise for most of the session time to answer the students' questions and queries, especially in one of the second year groups (Appendix 6). Additionally, they presented the general arguments in the PBL tutorials. This might be due to the tutor's response to the low prior knowledge of the students. In this situation, the tutor may seek to intervene to accelerate the tutorial process and to accomplish the required learning objectives. The tutorial functionality was relatively impacted by the tutor facilitation style.

The facilitator plays an important role in modelling the problem-solving and self-directed learning skills needed for self-assessing one's reasoning and understanding. Although the facilitator lessens the degree of his or her assistance and direction as

the group gains experience with the PBL method, she or he continues to monitor the group, making moment-to-moment decisions about how best to facilitate the PBL process. The facilitator directly supports several of the goals of PBL. First, the tutor models the problem-solving and self-directed learning processes. Secondly, the facilitator helps students learn to collaborate effectively. An underlying assumption of this is that when facilitators support the learning and collaboration processes, students are better able to construct flexible knowledge.

The relationship that could be detected between the students' perception toward the tutor facilitation style (Part A) and the efficacy of the tutor role (Part B) in the observed PBL sessions was contrasting. As the first year students perceived the tutor role positively as a facilitator and a guide to the PBL process, the effect of the tutors of the first year groups was detected to negatively affect their learning-oriented utterances. Most of the second year students viewed the tutor facilitating practices negatively while during the recorded PBL tutorials most of the tutors carried their facilitation roles enabling the students to effectively engage in the verbal interaction utilising the appropriate learning-oriented utterances.

The demographic factors discussed in this research were mostly contextual, meaning in a specific unique context, rather than situational. Home language and gender are two of the demographics that were investigated thoroughly in literature. This review found mixed outcomes on the influence of those two variables. Although, there was a negative effect when there was a dominating student, the unique findings of the present study is that when non-English language factor in conjunction with higher education level was present it did have a positive effect on the student contribution. Moreover, when those students were significant contributors they acted positively on the other students' verbal interaction and motivated them to participate more in group discussion. Age and education level, on the other hand, were speculated profusely and an impact was found on PBL functionality, although these factors probably confounded each other and impact on PBL functionality jointly.

The PBL methodology is designed to provide the efficient collaborative problem-solvers and future learners that are essentially required in health, medical and dental

science graduates. PBL outcomes and graduate attributes should be instilled in health, medical and dental sciences programs and this can be done by implementing a PBL methodology and learning path. As a hybrid medical program with what appeared to be a culturally diverse student body, Bond University's MBBS program was selected to evaluate and assess the effect of some variables that might impact or influence the functionality of the PBL curriculum. Students are one major variable of the successful adoption of the PBL experiment and, by investigating the impact of demographic variables on their PBL experience, the suitability of the PBL approach for different cultural backgrounds can be established.

5.1.3. PBL in the Bond University medical program and a Kuwaiti Dental Hygiene program

At the outset of this study, it was hypothesized that the demographics of students had no influence on the students' attitudes toward or interaction in the educational setting, especially with a student-centred methodology like PBL. The globalisation movements promote the standardisation of education methods and practices across cultures, apparently with little regard for cultural differences (Frambach *et al*., 2012). The results of this study provided an insight of the type of demographics that might have an influence on the students' perception and participation. Only age was a significant demographic factor that appeared to affect students' perception and participation of and in PBL tutorials. Language was used in this research as a reflection of culture and the results of the two instruments suggest that language or culture did not hind English-second language students. On the contrary, they perceived PBL more positively and engaged more actively than their English-speaking peers during PBL. Kuwait Dental Hygiene students are mostly originate from the Arab region and are non-English speakers but they undertake their courses in English. Notwithstanding the results of the present study, as educators we need to be aware of some of the nuances of language and culture when implementing PBL. As such, culture should be considered and adjusted for and because of the sharp contrast between their prior traditional education and PBL, their learning styles should be reformed to allow for the adaptability of the PBL learning method.

Kuwait is a small, developing country that is seeking to improve its health sciences

outcomes by improving the skills of graduates from its health professions. A conventional, more didactic type of education is still adopted in all of the higher education institutes, such as College of Health Sciences at the Public Authority for Applied Education and Training. The College wanted to develop more efficient thinkers and future problem-solvers rather than passive learners and dependent scholars. The first two years of the dental program at the College of Health Sciences are dedicated to basic sciences and the final two years to preclinical and clinical sciences. PBL is well suited for the first half of the curriculum, where PBL will develop students' higher order thinking skills. It would also motivate them to work collaboratively with their peers to improve the effectiveness of their group functionality and to build a scientific background that could be adopted during their current PBL tutorials and their later clinical years of study.

The preliminary stage of establishing the PBL learning educational approach is to convince the stakeholders of the College of Health Sciences, Kuwait, that this methodology will deliver the outcomes they desire. After the decision is made to implement the program, it is essential to engage local faculty early so that any external assistance results in skills transfer, leaving local faculty knowledgeable, experienced and empowered to continue development. The College could seek support from an experienced hybrid PBL institution, for example, Bond University and could utilise the existing PBL experts to train the Dental Hygiene staff. Moreover, it could purchase the relevant and appropriate cases for the successful implementation of PBL and, when the staff attain enough experience, could start writing their own PBL cases.

5.2. Limitations

The findings could not be generalised due to the anonymity of the sample participants. The limited time allocated for the repetition of this study sought the researcher to use the findings to evaluate the utility and applicability of the Bond medical program PBL experience to Kuwait Dental Hygiene program.

The survey group could not be linked to the observation and end of year (phase)

grades due to the anonymity of the questionnaire. Although the sample size was large enough to provide plausible results in some parts of the study (Part A), it could have been larger if more incentives had been introduced and if a longer time frame was allocated for students to answer the questionnaire.

For some parts of the study (Part B), some of the demographic characteristic subgroups contained a small number of participants. The counting and categorizing of learning-oriented utterances is assumed to be a proxy of participation but other factors should be considered for the assessment of students contribution to their learning in PBL as the active listener benefits to the discussion and might be an unnoticed participant than the active talker. Additionally, the relocation of participant groups to the only two rooms that had video cameras installed might have influenced the students' utterances and might be also the reason that other groups refused to participate in the videotaping process. Moreover, only two groups can be videotaped at a time, which would have provided logistical challenges for the researcher if more groups had decided to participate. This interference with the PBL tutorial system might have caused some discomfort to the students as well as having a coded badge which have affected students' behaviour possibly resulting in some students appearing quieter and more withdrawn in the video footage than they would normally be. While some interesting results were found in Part B of the study, the results can be questioned due to a small sample size.

5.3. Recommendations

To build on the results of this study, entire PBL tutorials should be videotaped for a longer period, i.e. each group should be recorded from the commencement until the end of the year, as this would better capture and monitor individual and group behaviour in PBL sessions over time. With greater exposure to the recording of PBL sessions, students may become more accustomed to the process and begin to behave more normally, which may affect their utterances positively in that they will be encouraged to participate more. Further, more groups should be recruited in order to increase the sample size and broaden the observational base on which the change and the progress of the individual's and group's interactions can be analysed.

If, in the future, these two instruments (the questionnaire and the learning-oriented utterances valid instrument), which correlated with the document review of the end of year assessment results, are used simultaneously, the same group should be surveyed and observed and their end of year (phase) assessment results collected. Student identity should be revealed to the researcher only to facilitate the analysis and provide reliability to the results. The videotaped sessions may, however, better measure a student's involvement and performance during PBL tutorials. Ground rules should be adopted in all PBL groups, such as assigning a chairperson or case reader, as this will motivate the mutual and significant contribution of the all students of all types of the students' participation styles, for example predominant, withdrawn or confrontational, thus allowing the tutor to concentrate on their facilitator duties.

Another option for further study would be an investigation of impact of tutors on PBL effectiveness. Tutors' facilitation style should be measured using a different measurement instrument than the student and there should be a set of videos available to the tutor to be as an evaluation method to enhance or remark on her or his facilitation style.

Due to time constraints, this study was conducted at a single university. The findings may therefore be inherently linked to local aspects of how PBL is conducted. To further the investigation, other academic contexts should be studied. In general, this research finds that the success of PBL depends on related factors such as group function, the quality of PBL problems and the tutor's competencies.

5.4. Conclusions

The assumption that students with different demographic factors or from different backgrounds perceived PBL differently was tested in a single university undergraduate program and proven to be incorrect. PBL was highly supported and accepted as a learning experience by the diverse groups of students involved in this research. All students, irrespective of their cultural background (as represented by home language) perceived the small PBL group environment positively.

First year students and School-leavers were the strongest advocates of PBL. Of the four demographic factors studied, it could be stated that the age factor and the education level factor both have a likable difference for the diverse groups in the study. On the other hand, the gender and home language variables had a relatively small effect on the students' perceptions of PBL. The presence of a language factor as a reflection to culture in conjunction with higher education level could have a negative impact (if there was a dominant contributor in the group) and a positive impact, where the PBL environment gave students of different cultural groups the confidence to participate more inn group verbal interaction.

Mature-aged (i.e. > 20 years) students with prior tertiary education worked more independently of the tutor than younger students, who placed more importance on the tutor's participation. The inclination toward a more tutor-directive style might be due to the lower levels of prior knowledge and a lower confidence amongst the younger students, many of whom entered university directly from school. Tutors with content expertise can, however, have a positive and negative impact on students' contribution. While a positive perception toward the tutor facilitation qualities was found among first year students, it was also noticed to negatively affect their verbal participation. Neither student nor tutor learning-oriented utterance results were found to impact on students' final grades.

The findings of this current study show that its diverse cultural student body is unlikely to be a barrier for the Dental Hygiene program at the College of Health Sciences, the Public Authority for Applied Education and Training academic body, Kuwait, to implement a hybrid PBL approach.

CHAPTER 6

REFERENCES

Albanese, M. A., & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine*, 68(1): 52-81.

Aldous, C. J. H., Leeder, S. R., Price, J., Jervie Sefton, A. E., & Teubner, J. K. (1997). A selection test for Australian graduate-entry medical schools. *Medical Journal of Australia*, 166(5): 247-250.

Aldred, S. E. (1997). *The Direct and Indirect Costs of Implementing Problem-based Learning into Traditional Professional Courses within Universities.* Department of Employment, Education, Training and Youth Affairs, Higher Education, 86.

Aldred, S. E., Aldred, M. J., Walsh, L. J., & Dick, B. (1997). *The direct and indirect costs of implementing problem-based learning into traditional professional courses within universities.* Canberra: Australian Government Publishing Service.

Antepohl, W., & Herzig, S. (1999). Problem-based learning versus lecture-based learning in a course of basic pharmacology: A controlled, randomized study. *Medical Education*, 33(2): 106-113.

Aries, E. (1976). Interaction Patterns and Themes of Male, Female and Mixed Groups. *Small Group Behaviour*, 7: 7-18.

Arts, J. A., Gijselaers, Wim H., & Segers, M. S. (2006). Enhancing problem-solving expertise by means of an authentic, collaborative, computer supported and problem-based course. *European Journal of Psychology of Education*, 21(1), 71-90.

Australian Bureau of Statistics, (2008). Adult Learning. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Chapter6202008

Australian Bureau of Statistics; (2013). The resident population of Australia.

Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/94713ad445ff1425ca25682000192af2/1647509ef7e25faaca2568a900154b63!OpenDocument. May 20, 2013.

Australian Government, Department of Education. (2002). Higher Order Thinking. Queensland, Australia.

Australian Government. (2008). Students: 2008 Summary of Higher Education Statistics. Canberra: Department of Education, Employment and Workplace relations Retrieved from http://www.deewr.gov.au/HigherEducation/Publications/HEStatistics/Publications/Documents/2008/HIEDSummaryReport2008.pdf.

Ausubel, D. P. (1968). *Educational Psychology, A Cognitive View*. New York: Holt, Rhinehart and Winston.

Azer, S. A. (2001). Problem-based learning. Challenges, barriers and outcome issues. *Saudi Medical Journal*, 22(5): 389-397.

Azer, S. A. (2010). Research in medical education is not just on telling a story. *Saudi Medical Journal*, 31(4): 456-458.

Azer, S. A. (2011). Introducing a problem-based learning program: 12 tips for success. *Medical Teacher*, 33(10): 808-813.

Bandura, A. (1969). *Principles of Behavioural Modification*. New York: Holt, Rhinehart and Winston.

Barrows, H. S. (1986). *A taxonomy of problem-based learning methods*. Medical Education, 20: 481-486.

Barrows, H. S. (1994). *Practice-Based Learning: Problem-Based Learning applied to medical education*. Springfield, IL Southern Illinois University School of Medicine.

Barrows, H. S., & Kelson, A. C. (1995). *Problem based learning in secondary education and the problem based learning institute*. Springfield, IL: Problem-Based Learning Institute.

Beachey, W. D. (2007). A Comparison of Problem-Based Learning and Traditional Curricula in Baccalaureate Respiratory Therapy Education. *Respiratory Care*, 52(11):1497–1506.

Beers, G. W. (2005). The effect of teaching method on objective test scores: Problem-based learning versus lecture. *Journal of Nursing Education*, 44(7): 305-309.

Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Woman's Ways of Knowing: The Development of Self, Voice and Mind*. New York: Basic Books.

Bereiter, C., & Scardamalia, M. (1989). Intentional learning as a goal of instruction. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 361–392). Hillsdale, NJ: Erlbaum.

Bernstein, P., Tipping, J., Bercovitz, K., & Skinner, H. (1995). Shifting students and faculty to a PBL curriculum: Attitudes changed and lessons learned. *Academic Medicine*, 70:245–247.

Birenbaum, M. (2003). New insights into learning and teaching and their implications for assessment. In M. Segers, F. Dochy and E. Cascallar, eds., *Optimising New Modes of Assessment: In Search for Qualities and Standards.* (pp. 13–36) Dordrecht: Kluwer Academic Publishers.

Blake, R. L., Hosokawa, M. C., & Riley, S. L. (2000). Student performances on Step 1 and Step 2 of the United States Medical Licensing Examination following implementation of a problem-based learning curriculum. *Academic Medicine*, 75(1): 66-70.

Blue, A., Stratton, T. D., Donnelly, M. B., Nash, P. P., & Schwartz, R. W. (1998), "Students' communication apprehension and its effects on PBL performance", *Medical Teacher*, 20(3): 217-221.

Blumberg, P., & Michael, J. A. (1992). Development of self-directed learning behaviours in a partially teacher-directed problem-based learning curriculum. *Teach Learn Med*, 4: 3-8.

Blumenfeld, P. C., Marx, R. W., Soloway, E., & Krajcik, J. (1996). Learning with Peers: From Small Group Cooperation to Collaborative Communities.

Educational Researcher, 25(8): 37-40.

Bochner, D., Badovinac, R. L., Howell, T. H., & Karimbux, N. Y. (2002). Tutoring in a problem-based curriculum: expert versus non expert. *Journal of Dental Education*, 66(11): 1246-1251.

Bond University, Academic Senate and the Senior Management Group. (2013). Graduate Attributes. http://www.bond.edu.au/about-bond/learning-and-teaching/context/graduate-attributes/index.htm.

Boon, P. K. (1980). *Attitudes of Staff towards Mature age Students*. Higher Education Advisory and Research Unit, Monash University: Acacia Press.

Bratt, A. M. (2003). A Large Group Hybrid Lecture and Problem-based Learning Approach to Teach Central Nervous System Pharmacology within the Third Year of an Integrated Masters Level Pharmacy Degree Course. *Pharmacy Education*, 3(1): 35-52.

Bressan, E. (2005). Group dynamics in the intercultural classroom: integration or deintegration. *Journal of Language and Learning*, 3(1).

Broverman, I. K., Vogel, S. R., Broverman, D. M., Clarkson, F. E., & Rosenkrantz, P. S. (1972). Sex-role stereotypes: A Current Appraisal. *J Soc Issues*, 28: 59-78.

Brown, A. L. (1995). The advancement of learning. *Educational Research*, 23(8): 4-12.

Brown, A. L., & Palincsar, A. S. (1989). Guided, cooperative learning, and individual knowledge acquisition. In L.B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 393- 451). Mahwah, NJ: Erlbaum.

Browne, M. W., & Cudeck, R. (1993). *Alternative ways of assessing model fit.* Beverly Hills, CA: Sage publications.

Bruner, J. S. (1959). Learning and Thinking. Harvard Educational Review, 29: 184-192. Bruner, J. S. (1968). *Toward a Theory of Instruction*. New York: Norton.

Bruner, J. S. (1971). *Toward a Theory of Instruction*. Cambridge, Massachusetts: Harvard University Press.

Byrne, B. M. (1994). *Structural equation modeling with EQS and EQS/Windows*. Thousand Oaks, CA: Sage Publications.

Caplow, J. A. H., Donaldson, J. F., Kardash, C. A., & Hosokawa, M. (1997). Learning in a problem-based medical curriculum: students' conceptions *Medical Education*, 31: 440-447.

Cariaga-Lo, L. D., Richards, B. F., Hollingsworth, M. A., & Camp, D. L. (1996). Non- cognitive characteristics of medical students: entry to problem based and lecture- based curricula. *Medical Education*, 30: 179–186.

Carter, Y. H., & Peile, E. (2007). Graduate entry medicine: curriculum considerations. *Medical Education*, 7(3): 253-256.

Chizhik, A. (1998). Collaborative learning through high-level verbal interaction: From theory to practice. *The Clearing House*, 72: 58–62.

Chapagain, M. L., Bhattacharya, N., Jain, B. K., Kaini, K. R., Koirala, S., & Jayawickramarajah, P. T. (1998). Introducing problem-based learning into an organ system programme. *Medical Teacher,* 20(6): 587-589.

Cheng, J. W. M., Alafris, A., Kirschenbaum, H. L., Kalis, M. M., & Brown, M. E. (2003). Problem-based learning versus traditional lecturing in pharmacy students' short-term examination performance. *Pharmacy Education,* 3(2): 117-125.

Child, D. (1990). The essentials of factor analysis. (2nd ed.). London: Cassel Educational Limited.

Chinn, C. A. & Brewer, W. F. (1993). The Role of Anomalous Data in Knowledge Acquisition: A Theoretical Framework and Implications for Science Instruction. *Review of Educational Research*, 63(1): 1-49.

Chung, E., Yew, E., & Schmidt, H. (2011). Effects of tutor-related behaviours on the process of problem-based learning. *Advances in Health Sciences Education*, 16(4): 491–503.

Cisneros, R. M., Salisbury-Glennon, J. D., & Anderson-Harper, H. M. (2002). Status of Problem-Based Learning Research in Pharmacy Education: A Call for Future Research. *American Journal of Pharmacy Education,* 66: 19-26.

Claessen, H. F. A., & Boshuizen, H. P. A. (1985). Recall of medical information by students and doctors. *Medical Education,* 19(1): 61-67.

Clark, R. C. (2000). Four Architectures of Instruction. *Performance Improvement*, 39(10): 31-38.

Cleverly, D. (2003). Implementing Inquiry-Based Learning in Nursing. London: Routledge.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the craft of reading, writing and mathematics. In L. B. Resnick (Ed.), *Knowing, learning and Instruction: Essays in honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Lawrence Erlbaum Associates.

Colliver, J. (2000). Effectiveness of Problem-based learning curricula: Research and theory. *Academic Medicine*, 75 (3).

Connolly, C., & Seneque, M. (1999). Evaluating problem-based learning in a multilingual student population. *Medical Education*, 33(10): 738-744.

Cooke, M., Irby, D. M., Sullivan, W., & Ludmerer, K. M. (2006). Medical education: American medical education 100 years after the flexner report. New *England Journal of Medicine*, 355(13), 1339-1344+1306.

Crawford, M. (1995). Talking Difference: On Gender and Language London: Sage.

Crosson, J. C., Deng, W., & Brazeau, C. (2004). Evaluating the effect of cultural competency training on medical student attitudes. *Family Medicine*, 36: 199-203.

Cunningham, C. E., Deal, K., Neville, A., Rimas, H., & Lohfeld, L. (2006). Modeling the problem-based learning preferences of McMaster University undergraduate medical students using a discrete choice conjoint experiment.

Advances in Health Sciences Education: Theory and Practice, 11:245–266.

Czabanowska, K., Moust, J. H. C., Meijer, A. W. M., Schröder-Bäck, P., and Roebertsen, H. (2012). *Journal of University Teaching & Learning Practice*, 9(1): 1-13

Darby, M. L., & Bowen, D. M. (1993). *Research Methods for Oral Health Professionals: An Introduction*. Pocatello, Idaho: Mosby.

Das, M., Mpofu, D. J. S., Hasan, M. Y., & Stewart, T. S. (2002). Student perceptions of tutor skills in problem-based learning tutorials. *Medical Education*, 36(3): 272-278.

De Grave, W. S., Boshuizen, H. P. A., & Schmidt, H. G. (1996). Problem based learning: Cognitive and metacognitive processes during problem analysis. *Instructional Science*, 24(5): 321-341.

De Grave, W. S., Dolmans, D. H. J. M., & van der Vleuten, C. P. M. (1998). Tutor intervention profile: reliability and validity. *Medical Education*, 32: 262-268.

De Grave, W. S., Schmidt, H. G., & Boshuizen, H. P. A. (2001). Effects of problem-based discussion on studying a subsequent text: A randomized trial among first year medical students. *Instructional Science*, 29(1): 33-44.

Derry, S. J., Siegel, M., & Stampen, J. (2002). The STEP system for collaborative case-based teacher education: Design, evaluation, and future directions. In G. Stahl (Ed.), *Proceedings of CSCL 2002* (pp. 209–216). Erlbaum Hillsdale NJ.

Dewey, J. (1938). *Experience and Education*. NY: Kappa Delta Pi.

Distlehorst, L. H., Dawson, E., Robbs, R. S., & Barrows, H. S. (2005). Problem-based learning outcomes: The glass half-full. *Academic Medicine*, 80: 294–299.

Dobson, A., & Barnett, A. (2008). *An Introduction to Generalized Linear Models* (3rd ed.): Chapman & Hall/CRC

Dolmans, D. H. J. M., Gijselaers, W. H., Schmidt, H. G., & Van Der Meer, S. B. (1993). Problem effectiveness in a course using problem-based learning. *Academic Medicine*, 68(3): 207-213.

Dolmans, D. H. J. M, Snellen-Balendong, H., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (1997). Seven principles of effective case design for a problem-based curriculum. *Medical Teacher*, 19(3): 185-189.

Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (1998). Motivational and cognitive processes influencing tutorial groups. *Academic Medicine*, 73: S22-S24.

Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., van der Vleuten, C. P. M., & Wijnen, W. H. F. W. (2001). Solving problems with group work in problem-based learning: Hold on to the philosophy. *Medical Education*, 35(9): 884-889.

Dolmans, D. H. J. M., Gijselaers, W. H. , Moust, J. H., De Grave, W. S., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2002). Trends in research on the tutor in problem based learning: Conclusions and implications for educational practice and research. *Medical Teacher*, 24: 173-180.

Dolmans, D. H. J. M., De Grave, W., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Problem-based learning: future challenges for educational practice and research. *Medical Education*, 39: 732–741.

Downing, K. (2012). The Impact of Moving Away from Home on Undergraduate Metacognitive Development. In Heidi, K., Bradley J., M. and Joseph L., A. (Eds.) *Current Topics in Children's Learning and Cognition*. CC BY 3.0 license

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The Power of Problem-based Learning: A Practical "how To" for Teaching*. Stirling, VA: Stylus.

Dyke, P., Jamrozik, K., & Plant, A. (2001). A Randomized Trial of a Problem-based Learning Approach for Teaching Epidemiology. *Academic Medicine*, 76(4): 373–379.

Elstein, A. S., & Schwartz, A. (2000). Clinical reasoning in medicine. In J. Higgs & M. A. Jones (Eds.), *Clinical Reasoning in the Health Professions* (2nd ed.). Oxford: Butterworth-Heinmann.

Edens, K.M. (2000). Preparing problem solvers for the 21st century through Problem-based learning. *College Teaching*, 48(2): 55-60.

Eva, K. W., Cunnington, J. P. W., Reiter, H. I., Keane, D. R., & Norman, G. R. (2004). How Can I Know What I Don't Know? Poor Self-Assessment in a Well-Defined Domain. *Advances in Health Sciences Education*, 9(3): 211-224.

Evans, N., Forney, D. S., Guido, F. M., Lori D. Patton, L. D., & Renn, K. A. (2009) Student Development in College: Theory, Research, and Practice. (2nd ed.). John Wiley & Sons. 480 pages.

Falk-Nilsson, E., Walmsley, D., Brennan, M., Fournier, D. M., Junfin G. B., Haden, K., . . . Petersson, K. (2002). 1.2 Cognition and learning. *European journal of dental education: official journal of the Association for Dental Education in Europe*, 6(Suppl. 3): 27-32.

Feinstein, J. (2006). *The nature of creative development*. Stanford CA: Stanford Business Books.

Fletcher, J. K., Jordan, J. V., & Miller, J. B. (2000). Women and the workplace: Applications of a Psychodynamic theory. *American Journal of Psychoanalysis*, 1: 243–261.

Fosnot, C. T. (2013). Constructivism: Theory, Perspectives, and Practice, Second Edition. (2013). In: Fosnot, C. T. (Ed.) (2nd ed). Teachers College Press. Amsterdam Avenue, New York, NY.

Frambach, E. M., Driessen, E. W., Chan, L-C., & van der Vleuten, C. P. M. (2012). Rethinking the globalisation of problem-based learning: how culture challenges self- directed learning. *Medical Education*, 46: 738–747.

Fung, N. L. Y. (2013). An exploration of the differing perceptions of problem-based learning (PBL) from students and facilitators of diverse cultural backgrounds, in the fields of theological and nursing education. ProQuest LLC. 422 pages.

Gallagher, S. A., Stepien, W. J., & Rosenthal, H. (1992). The Effects of Problem-Based Learning on Problem Solving. *Gifted Child Quarterly*, 36(4): 195-200.

Gallagher, S A (1997). Problem-based learning: Where did it come from, what does it do and where is it going?. *Journal for the Education of the Gifted*, 20(4): 332–362.

Gawelek, M. A., Mulqueen, M., & Tarule, J. M. (1994). Woman to Women: Understanding the Needs of our Female Students. In S. Munison-Deats, & L. Tallent-Lenker (Ed.), *Gender and academe: feminist pedagogy and politics*. London: Rowman & Littlefield.

George, D., & Mallery, P. (2003). *SPSS for windows step by step: A sample Guide & Reference*. Boston: Allyn & Bacon.

Gessner, R. (1956). Eduard C. Lindeman - 1885-1955. *New Republic*, 135: 21-21.

Gijbels, D., Filip Dochy, F., Bossche, P. V. & Segers, M. (2005). Effects of Problem-Based Learning: A Meta-Analysis from the Angle of Assessment. *Review of Educational Research*, 75(1):27–61.

Gijselaers, W. H. & Schmidt, H.G. (1990) Development and evaluation of a causal model of problem-based learning, in: Z.M. Nooman, H.G. Schmidt & E.S. Ezzat (Eds.) *Innovation in Medical Education: An Evaluation of its Present Status*, (pp. 95–113). New York, Springer.

Gill, E., Tuck, A., Wai Gin Lee, D., & Beckert, L. (2004). Tutorial Dynamics and Participation in small groups: a student perspective in a multicultural setting. *Journal of New Zealand Medical Association*, 117(1205).

Gilligan, C. (1982). *In a Different Voice: Psychological Theory and Women's Development*. Cambridge, MA: Harvard University Press.

Glaser, R. (1991). The maturing of the relationship between the science of learning and cognition and educational practice. *Learning and Instruction*, 1(2): 129–144.

Graham, D. H., Huy, P., Patricia, M. L., & Gordon, J. (2002). Student evaluation of expert and non-expert problem-based learning tutors. *Medical Teacher*, 24(5): 544–549.

Gurpinar, E., Musal, B., Aksakoglu, G., & Ucku, R. (2005). Comparison of knowledge scores of medical students in problem-based learning and traditional curriculum on public health Topics. *BMC Medical Education*, 5: 7-12.

Gwee, M. C. (2008). Globalization of Problem-based Learning (PBL): Cross-cultural Implications. *The Kaohsiung Journal of Medical Sciences*, 24(3): S14-S22.

Haghparast, N., Sedghizadeh, P. P., Shuler, C. F., Ferati, D., & Christersson, C. (2007). Evaluation of student and faculty perceptions of the PBL curriculum at two dental schools from a student perspective: a cross-sectional survey. *European journal of dental education: official journal of the Association for Dental Education in Europe*, 11(1): 14-22.

Harris, K.R. & Alexander, P.A. (1998). Integrated, constructivist education: Challenge and reality. *Educational Psychology Review*, 10(2): 115–127. 461

Heim, P., & Golant, S. K. (1992). *Hardball for women: Winning at the game of business*. New York, NY: Penguin Group.

Hendry, G. D., Frommer, M. & Walker, R. A. (1999). Constructivism and problem based learning. *Journal of further and higher education*. 23(3): 359-371.

Hendry, G. D., Ryan, G., Harris, J. (2003). 'Group problems in problem-based learning'. *Medical Teacher*, 25 (6): 609–616.

Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational Psychologist*, 41(2): 111–127.

Hmelo-Silver, C. E. (2000). Knowledge recycling: Crisscrossing the landscape of educational psychology in a Problem-Based Learning Course for Preservice Teachers. *J Excell Coll Teach*, 11: 41-56.

Hmelo-Silver, C. E. (2002). Collaborative ways of knowing: Issues in facilitation. In G. Stahl (Ed.), *Proceedings of CSCL 2002* (pp. 199-208). Erlbaum, Hillsdale, NJ.

Hmelo-Silver, C. E., & Barrows, H. S. (2003). Facilitating collaborative ways of knowing. Manuscript submitted for publication.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural Equation Modelling: Guidelines for determining model fit. *The Electronic Journal of Business Research Methods*, 6: 53-60.

Houlden, R. L., Collier, C. P., Frid, P. J., John, S. L., & Pross, H. (2001). Problems identified by tutors in a hybrid problem-based learning curriculum. *Academic Medicine*, 76(1): 81.

Hoyle, R. H. (2000). Confirmatory factor analysis. In H. E. A. Tinsley & S. D. Brown (Eds.), *Handbook of applied multivariate statistics and mathematical modeling* (pp. 465-497). New York: Academic Press.

Hoyle, R. H., & Duvall, J. L. (2004). Determining the number of factors in exploratory and confirmatory factor analysis. In D. Kaplan (Ed.), *The Sage handbook of quantitative methodology for the social sciences*. Thousand Oaks, CA: Sage.

Hsieh, C., & Knight, L. (2008). Problem-Based Learning for Engineering Students: An Evidence-Based Comparative Study. *The Journal of Academic Librarianship*, 34(1): 25-30. doi: 10.1016/j.acalib.2007.11.007

Hughes, L. & Lucas, J. (1997). An evaluation of problem based learning in the Multiprofessional education curriculum for the health professions. *Journal of interprofessional care*, 11(1): 77-88.

Imafuku, R. (2007). *Students' Academic Experience in Medical Problem-Based Learning Tutorials*. Paper presented at the Proceedings of the Independent Learning Association 2007 Japan Conference: Exploring theory, enhancing practice: Autonomy across the disciplines. Kanda University of International

Studies, Chiba Japan.

Kahraman, S, Baran, T, & Saatçı, I A. (2011). The fourth visit of John Dewey to Turkey (Problem Based Learning Experience in Turkey) *e-Journal of New World Sciences Academy*, 6(4): 2460-2468.

Kaplowitz, L. E., & Block, S. D. (1998). Gender-related group dynamics in problem-based learning: A retrospective study. *Academic Psychiatry*, 22(3): 197-202.

Kaufman, D. M., & Holmes, D. B. (1998). The relationship of tutors' content expertise to interventions and perceptions in a PBL medical curriculum. *Medical Education*, 32: 255-261.

Kay, L., Pearson, S., & Rolfe, I. (2002). The influence of admission variables on first year medical school performance: A study from Newcastle University. Australia. *Medical Education*, 36: 154-159.

Kelson, A., & Distlehorst, L. (2000). Groups in problem-based learning (PBL): Essential elements in theory and practice. In D. Evensen & C. Hmelo (Eds.), *Problem-based learning: A research perspective* (pp. 167–185). Mahwah, NJ: LEA.

Khoo, H. E. (2003). Implementation of problem-based learning in Asian medical schools and students' perceptions of their experience. *Medical Education*, 37(5): 401-409.

Kilroy, D. A. (2004). Problem based learning. *Emergency Medical Journal*, 21: 411-413.

Kim, M., & Bresnahan, M. (1996). Cognitive basis of gender communication: A cross-cultural investigation of perceived constraints in requesting. *Communication Quarterly*, 44: 53-69.

Knowles, M. S. (1968). Andragogy, not pedagogy!. *Adult Leadership*, 16(10): 350-352, 386.

Knowles, M. S. (1980). *Modern Practice of Adult Education: From Pedagogy to Andragogy*. Chicago: Follett.

Knowlton, D. S. (2003). Preparing Students for Educated Living: Virtues of Problem-Based Learning across the Higher Education Curriculum. *New Directions for Teaching and Learning*, 2003(95): 5-12.

Koh, G. C., Khoo, H. E., Wong, M. L., & Koh, D. (2008). The effects of problem-based learning during medical school on physician competency: a systematic review. *Canadian Medical Association Journal*, 178: 34-41.

Kolodner, J. L., Hmelo, C. E., & Narayanan, N. H. (1996). Problem-based learning meets case-based reasoning. In D. C. Edelson & E. A. Domeshek (Eds.), *Proceedings of ICLS 96* (pp. 188–195). Charlottesville, VA: AACE.

Koschmann, T. D., Myers, A. C., Feltovich, P. J., & Barrows, H. S. (1994). Using Technology to Assist in Realizing Effective Learning and Instruction: A Principled Approach to the Use of Computers in Collaborative Learning. *Journal of the Learning Sciences*, 3(3): 227-264.

Krishnan, S., Gabb, R., & Vale, C. (2011). Learning cultures of problem-based

learning teams. *Australasian journal of engineering education*, 17(2): 67-78.

Krosnick, Jon A (1999). Survey Research. *Annual Review of Psychology*, 50: 537-567.

Krupnick, C. G. (1985). Women and Men in the Classroom: Inequality and Its Remedies. *Teaching and Learning: Journal of the Harvard Danforth Centre*, 1: 18-25.

KUNA. (2012). Retrieved from: http://158.50.10.7/ArticleDetails.aspx?id=2234864&language=en.

Lancaster, C. J., Bradley, E., Smith, I. K., Chessman, A., Stroup-Benham, C. A., & Camp, M. G. (1997). The effect of PBL on students' perceptions of the learning environment. *Academic Medicine*, 72(10 SUPPL. 1): S10-S12.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Lieberman, S. A., Stroup-Benham, C. A., Peel, J. L., & Camp, M. G. (1997). Medical student perception of the academic environment: A prospective comparison of traditional and problem-based curricula. *Academic Medicine*, 72(10 SUPPL. 1): S13-S15.

Lin, C. (2005). Medical students' perception of good PBL tutors in Taiwan. *Teaching & Leaning Medical Journal*, 17: 179-183.

Login, G. R., Ransil, B. J., Meyer, M., Truong, N. T., Donoff, R. B., & McArdle, P. J. (1997). Assessment of preclinical problem-based learning versus lecture-based learning. *Journal of Dental Education*, 61(6): 473-479.

Lohman, M. C., & Finkelstein, M. (2002). Designing cases in problem-based learning to foster problem-solving skill. *European journal of dental education: official journal of the Association for Dental Education in Europe*, 6(3): 121-127.

Loudon, R. F., Anderson, P. M., Gill, P. S., & Greenfield, S. M. (1999). Educating Medical Students for Work in Culturally Diverse Societies. *JAMA*. 282(9):875-880.

Lawson, K. A., Chew, M., & Van Der Weyden, M. B. (2004). The new Australian medical schools: daring to be different. *Medical Journal of Australia*, 181(11-12):662-666.

Lycke, K. H. (2002). Inside PBL groups: Observation, confirmations and challenges. *Education for Health*, 15: 326-334.

Margetson, D. (1998). What counts as Problem Based Learning?. *Education for Health*, 11: 193-201.

Marjanovic, O. (1997). *Teaching International Students in the Electronic Collaborative Classroom*. Paper presented at the 8th Annual Conference, ISANA '98. International Education: In it Together, Melbourne, Australia.

Marton, F., Booth, S. (1997). *Learning and Awareness*. New Jersey: Lawrence Erlbaum Associates Inc.

Maslow, A. H. (1970). *Motivation and Personality*. New York: Harper and Row.

Maslow, A. H. (1972). Defense and Growth. In M. L. Silberman (Ed.), *The Psychology of Open Teaching and Learning*. Boston: Little Brown.

Mayo, P., Donnelly, M. B., Nash, P. P., & Schwartz, R. W. (1993). Student perceptions of tutor effectiveness in a problem-based surgery clerkship. *Teaching & Leaning Medical Journal*, 4: 227-233.

McLaughlin, M. L., Cody, J. M., Krane, M. L., & Robey, C. S. (1981). Sex differences in story receipt and story sequencing behaviours in dyadic conversations. *Human Communication Research*, 7:99-116.

McLean, M., Van Wyk, J. M., Peters-Futre, E. M., & Higgins-Opitz, S. B. (2006). The small group in problem-based learning: More than a cognitive 'learning' experience for first- year medical students in a diverse population. *Medical Teacher*, 28(4): e94-e103.

McParland, M., Noble, L. M., & Livingston, G. (2004). The effectiveness of problem-based learning compared to traditional teaching in undergraduate psychiatry. *Medical Education*, 38(8): 859-867.

Mennin, S. P. (2007). Small-group problem-based learning as a complex adaptive system. *Teaching and Teacher Education*, 23(3): 303-313.

Mennin, S. P., Friedman, M., Skipper, B., Kalishman, S., & Snyder, J. (1993). Performances on the NBMEI, II, and III by medical students in the problem-based learning and conventional tracks at the University of New Mexico. . *Academic Medicine*, 68: 616–624.

Merriam, S. B. (2001). Andragogy and Self-Directed Learning: Pillars of Adult Learning Theory. *New Directions for Adult and Continuing Education*, 2001(89): 3-14.

Messick, S. (1988). The once and future issues of validity: Assessing the meaning and consequences of measurement. In H. B. Wainer, H. I. (Ed.), *Test Validity* (pp. 33-45). Hillsdale, NJ: Lawrence Erlbaum Associates.

Messick, S. (1989). Validity. In R. L. Linn (Ed.), *Educational measurement* (3rd ed.). (pp. 13-103). New York, USA: Macmillan.

Miflin, B. (2004). Small groups and problem-based learning: Are we singing from the same hymn sheet? Medical Teacher, 26:444–450.

Miflin, B. M., Campbell, C. B., & Price, D. A. (1999). A lesson from the Introduction of a Problem-Based, Graduate Entry Course: the effects of different views of self- direction. *Medical Education*, 33: 801-807.

Miflin, B. M., Harris, P., Donald, K., Bore, P., Parker, M., Groves, M., & Hardie, I. (2003). Graduate entry to medical studies: thoughts from 'down under'. *Medical Teacher*, 25(2): 109-111.

Miller, M. B. (1995). Coefficient Alpha: A Basic Introduction from the Perspective of Classical Test Theory. *Structural Equation Modeling*, 2(3): 255-273.

Miller, S. K. (2003). A comparison of student outcomes following problem-based learning instruction versus traditional lecture learning in a graduate

pharmacology course. *Journal of the American Academy of Nurse Practitioners*, 15(12): 550-556.

Moore, G. T., Block, S. D., Style, C. B., & Mitchell, R. (1994). The influence of the New Pathway curriculum on Harvard medical students. *Academic Medicine*, 69(12): 983-989.

Mpofu, D. J. S., Lanphear, J., Stewart, T., Das, M., Ridding, P., & Dunn, E. (1998). Facility with the English language and problem-based learning group interaction: Findings from an Arabic setting. *Medical Education*, 32(5): 479-485.

Neville, A. J. (1999). The problem-based learning tutor: teacher? facilitator? evaluator? *Medical Teacher*, 21(4): 393–401.

Neville, A. J. (2009). Problem-based learning and medical education forty years on. A review of its effects on knowledge and clinical performance. Medical Principles and Practice, 18: 1-9, 17.

Newble, D., Norman, G., & van der Vleuten, C. (2000). Assessing clinical reasoning. In J. H. M. Jones (Ed.), *Clinical Reasoning in the Health Professions* (2nd ed.). Oxford: Butterworth-Heinemann.

Nieminen, J., Sauri, P., & Lonka, K. (2006). On the relationships between group functioning and study success in problem-based learning. *Medical Education*, 40: 64-71.

Nijstad, B. A., Stroebe, W., & Lodewijkx, H. F. M. (2003). Production blocking and idea generation: Does blocking interfere with cognitive processes?. *Journal of Experimental Social Psychology*, 39: 531–548.

Norman, G. R., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: A review of the evidence. *Academic Medicine*, 67(9): 557-565.

Norman, G. R., & Schmidt, H. G. (2000). Effectiveness of problem-based learning curricula: Theory, practice and paper darts. *Medical Education*, 34(9): 721-728.

Nunez, A. E. (2000). Transforming cultural competence into cross-cultural efficacy in women's health education. *Academic Medicine*, 75: 1071-1080.

O'Hanlon, A., Winefield, H., Hejka, E., & Chur-Hansen, A. (1995). Initial responses of first year medical students to problem-based learning in a behavioural science course: role of language background and course content. *Medical Education*, 29(3): 198–204.

Omeri, A. (2003). Meeting the challenges of cultural diversity in the academic setting. *Nurse Education in Practice*, 3(1): 5-22.

Oppenheim, A. (1992). *Questionnaire Design, Interviewing and Attitude Measurement*. London.

Ozuah, P. O. (2005). First, There Was Pedagogy And Then Came Andragogy. *Einstein Journal of Biology and Medicine*, 21: 83-87.

Pallant, J. (2011). *SPSS Survival Manual* (4th ed.). Crows Nest NSW Australia: Allen & Unwin.

Patel, V. L., Groen, G. J., & Norman, G. R. (1991). Effects of conventional and problem- based medical curricula on problem solving. *Academic Medicine*, 66: 380-389.

Patel, V. L., Arocha, J. F., Branch, T., & Karlin, D. R. (2004). Relationship between Small Group Problem-Solving Activity and Lectures in Health Science Curricula. *Journal of Dental Education*, 68(10): 1058-1080.

Pea, R. D. (1993). Practices of Distributed Intelligence and Designs for Education. In G. Salomon (Ed.), *Distributed cognition* (pp. 47-87). New York: Cambridge University Press.

Piaget, J. (1977). The development of thought: Equilibrium of cognitive structures. New York: Viking Press.

Pintrich, P., & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In M. L. Maeher, & P.R. Pintrich (Ed.), *Advances in motivation and achievement: Goals and self-regulatory processes* (Vol. 7). Greenwich, CT: JAI Press.

Popper, K.R. (1959). *The Logic of Scientific Discovery*. London: Hutchinson.

Raiche, G., & Magis, D. (2010). nFactors: Parallel analysis and non graphical solutions to the Cattell's scree test. [R package Version 2.3.1.]. *http://cran.r-project.org/web/packages/nFactors/index.html.*

Rankin, J. A. (1992). Problem-based medical education: Effect on library use. *Bulletin of the Medical Library Association*, 80(1): 36-43.

Remedios, L., Clarke, D., & Hawthorne, L. (2008a). Framing Collaborative Behaviors: Listening and speaking in problem-based learning. *The Interdisciplinary Journal of Problem-Based Learning*, 2: 1-20.

Remedios, L., Clarke, D., & Hawthorne, L. (2008b). The silent participant in small group collaborative learning contexts. *Active Learning in Higher Education*, 9(3): 201-216.

Revelle, W. (2013). Psych: Procedures for Personality and Psychological Research. http://CRAN.R-project.org/package=psych. Version 1.3.2.

Reynolds, F. (2003). Initial experiences of interprofessional problem-based learning: a comparison of male and female students' views. *Journal of Interprofessional Care*, 1(17): 35-44.

Richards, B. F., Ober, K. P., Cariaga-Lo, L., Camp, M. G., Philip, J., McFarlane, M., . . . Zaccaro, D. J. (1996). Ratings of students' performances in a third-year internal medicine clerkship: A comparison between problem-based and lecture-based curricula. *Academic Medicine*, 71(2): 187-189.

Rienties, B., & Tempelaar, D. T. (2013). The role of cultural dimensions of international and Dutch students on academic and social integration and academic performance in the Netherlands. *International Journal of Intercultural Relations*, 37(2): 188-201.

Ripkey, D. R., Swanson, D B, & Case, S M. (1998). School to-school differences in Step 1 performance as a function of curriculum type and use of Step 1 in

promotion/graduation requirements. *Academic Medicine*, 73(10): S16–S18.

Rogers, C. R. (1967). *Freedom to Learn*. Columbus, Ohio: Merrick.

Rolfe, E., Andren, J. M., & Pearson, S. (1995). Clinical competence of interns. *Medical Education*, 29: 225-230.

Rose, M., & Best, D. (Ed.). (2005). *Transforming Practice through Clinical Education, Professional Supervision and Mentoring*. China: Elservier Limited.

Rosenthal, R., & Rosnow, R. L. (1991). *Essentials of Behavioral Research: Methods and Data Analysis* (2 ed.): McGraw-Hill Publishing Company.

Rourke, L., Anderson, T., Garrison, R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence In Education*, 12(1): 8-22.

Saito, H., Harun, I., Kuboki, I., & Hendayana, S. (2007). "A study of the partnership between Schools & Universities to improve science and mathematics education in Indonesia". *International Journal of Educational Development*, 27: 194-204.

Salomon, G. (1993). No Distribution without Individuals Cognition: A dynamic interactional view. In G. Salomon (Ed.), *Distributed Cognitions* (pp. 111-138). New York: Cambridge University Press.

Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. *Educational Psychologist*, 24: 113-142.

Sapsford, R. J. (1999). *Survey Research*: SAGE Publications Ltd.

Saris, W. & Stronkhorst, H. (1984). *Causal modelling in nonexperimental research*.

Amsterdam: Sociometric Research Foundation. Amsterdam, the Netherlands.

Savin-Baden, M. (2000) *Problem-based learning in Higher Education*: Untold Stories. Buckingham: Society for Research in Higher Education and Open University Press.

Schmidt, H. G. (1983). Problem-based learning: rationale and description. *Medical Education*, 17(1): 11-17.

Schmidt, H. G. (1993). Foundations of problem-based learning: some explanatory notes. *Medical Education*, 27(5): 422-432.

Schmidt, F. L. (1996). Statistical significance testing and cumulative knowledge in psychology: Implications for training of researchers. *Psychological Methods*, 1: 115–129.

Schmidt, H. G., & Moust, J. H. C. (1995). What makes a tutor effective? A structural- equations modelling approach to learning in problem based curricula. *Academic Medicine*, 70: 708–714.

Schmidt, H. G., & Moust, J. H. C. (2000). Processes that shape small-group tutorial learning: A review of research In D. H. Evensen & C. E. Hmelo (Eds.), *Problem Based Learning: a Research Perspective on Learning Interactions* (pp. 19-52). Mahwah, NJ: Erlbaum.

Schmidt, H. G. & van der Molen, H. T. (2001). Self-reported competency ratings of graduates of a problem-based medical curriculum. *Academic Medicine*, 76 (5): 466-468.

Schmidt, H. G., De Grave, W. S., De Volder, M. L., Moust, J. H. C. , & Patel, V. L. (1989). Explanatory models in the processing of science text: The role of prior knowledge activation through small-group discussion. *Journal of Educational psychology*, 81: 610-619.

Schmidt, H. G., Arend, A. V. D., Moust, J. H. C., Kokx, I., & V., Boon L. (1993). Influence of tutors' subject-matter expertise on student effort and achievement in problem-based learning. *Academic Medicine*, 68: 784-791.

Schmidt, H. G., Dolmans, D., Gijselaers, W.H. & Des Marchais, J. E. (1995). Theory guided design of a rating scale for course evaluation in problem-based curricula, *Teaching and Learning in Medicine*, 7(2), (pp. 82–91).

Schmidt, H. G., Loyens, S. M. M., van Gog, T., & Paas, F. (2006). Problem-Based Learning is Compatible with Human Cognitive Architecture: Commentary on Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, 42(2): 91–97.

Segers, M. S., & Dochy, F. (2001). New Assessment Forms in Problem-based Learning: The value-added of the students' perspective. *Studies in Higher Education*, 26(3): 327-343.

Segers, M., Dochy, F., & Cascallar, E. (2003). Optimizing new modes of assessment: In search of qualities and standards. Boston/Dordrecht: Kluwer Academic.

Severiens, S. E., & Schmidt, H. G. (2008). Academic and Social Integration and Study Progress in Problem Based Learning. *Higher Education: The International Journal of Higher Education and Educational Planning*, 58(1): 59-69.

Silén, C. (2003). Responsibility and independence in learning – what is the role of the educators and the framework of the educational programme? In C. Rust (Ed.), *Improving Student Learning: Improving Student Learning – Theory, Research and Practice* (pp. 249-262). Oxford: The Oxford Centre for Staff and Learning Development.

Singaram, V. S., Dolmans, D. H. J. M., Lachman, N., & van der Vleuten, C. P. M. (2008). Perceptions of problem-based learning (PBL) group effectiveness in a socially- culturally diverse medical student population. *Education for Health: Change in Learning and Practice*, 21(2).

Skinner, B. F. (1974). *About Behaviourism*. New York: Knopf.

Spencer, J. A, & Jordan, R. K. (1999). Learner cantered approaches in medical education. *BMJ*, 318: 1280-1283.

SPSS. (2013). Statistical Package for the Social Sciences (Version 21.0). Chicago Ill: SPSS Inc.

Stallman, H. M., & Hurst, C. P. (2011). Factor structure of the Frost Multidimensional Perfectionism Scale in university students. *Australian Psychologist*, 46(4): 229–236.

Strange, C. (2004). Constructions of student development across the generations. Special Issue: Serving the Millennial Generation. *New Directions for Student Services*, 2004(106): 47-57

Strobel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdisciplinary Journal of Problem- based Learning*, 3(1): 44-58.

Stupans, I., Angley, M. T., March, G., & Soulsby, N. (2005). Graduate qualities: Exploring problem solving in the applied pharmacotherapeutics curriculum at the University of South Australia. *Pharmacy Education*, 5(3-4): 261-265.

Suebnukarn, S., & Haddawy, P. (2006). Modeling individual and collaborative problem- solving in medical problem-based learning. *User Modeling and User-Adapted Interaction*, 16(3): 211-248.

Suleman, W., Iqbal, R., Alsutan, A., & Baig S. M. (2010). Perception of 4th year Medical students about Problem Based Learning. *Pakistan Journal of Medical Science*, 26(4): 871-874.

Sultana, A. M., & bin Lazim, A. S. (2011). Gender Studies in Teacher Education: An Empirical Research. *Asian Social Science*, 7(12): 168-174.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics*. New York Allyn and Bacon.

Tang, M., & Neber, H. (2008). Motivation and self-regulated science learning in high- achieving students: Difference related to nation, gender, and grade level. *High Ability Studies*, 19(2): 103-116.

Tannen, D. (1994). *The relativity of linguistic strategies: rethinking power and solidarity in gender and dominance*. In: Gender and Discourse. Oxford University Press, Oxford and New York, (pp.19–52).

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2: 53-55.

Taylor, B & Kroth, M. (2009). Andragogy's Transition into the Future: Meta-Analysis of Andragogy and Its Search for a Measurable Instrument. *Journal of Adult Education*, 38(1): 1-11.

Taylor, D., & Miflin, B. (2008). AMEE GUIDE NO. 36 Problem-based learning: Where are we now? *Medical Teacher*, 30: 742-763.

Teakle, N. (2008). Problem based learning for first year students: Perspectives from students and laboratory demonstrations. *TLForum.lsn.curtin.edu.au//tif/tif/2008/refereed/Teakle*.

Tearle, P., Dillon, P., & Davies, N. (1999). Use of information technology by English university teachers. Developments and trends at the time of the National Inquiry Into Higher Education. *Journal of Further and Higher Education*, 23(1): 5-15.

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. (195 pages). Washington, DC, US: American Psychological Association.

Tipping, J., Freeman R. F., Rachlis, A. R. (1995). Using faculty and student perceptions of group dynamics to develop recommendations for PBL training. *Academic Medicine,* 70(11): 1050–1052.

Tiwari, A., Lai, P., So, M., & Yuen, K. (2006). A comparison of the effects of problem-based learning and lecturing on the development of students' critical thinking. *Medical Education*, 40(6): 547-554.

Treloar, C., McCall, N., Rolfe, I., Pearson, S.-A., Garvey, G. & Heathcote, A. (2000), Factors affecting progress of Australian and international students in a problem-based learning medical course. *Medical Education*, 34: 708–715.

Tsou, K., Cho, S., Lin, C., Sy, L. B., Yang, L., Chou, T., & Chiang, H. (2009). Short-term outcomes of a near-full PBL curriculum in a new Taiwan medical school. *Kaohsiung Medical Sciences*, 25: 282-293.

Tuckman, B. W. (1965). Development sequence in small groups. *Psychological Bulletin*, 63(6): 384-399.

Van Boxtel, C., Van der Linden, J., & Kanselaar, G. (2000). Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction*, 10: 311–330.

Van den Hurk, M. M., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., V Muijtjens, A. M. M., & Van Der Vleuten, C. P. M. (1999). Impact of Individual Study on Tutorial Group Discussion. *Teaching and Learning in Medicine,* 11(4): 196-201.

Van den Hurk, M. M., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2001). Testing a causal model for learning in a problem-based curriculum. *Advances in Health Sciences Education,* 6:141-149.

Van Enckevort, G. (1971). *Andragology: A New Science*. Amersfoort, The Netherlands: Nederlands Centrum Voor Volksontwikkeling.

Vermunt, J. D. (2005). Relations between student learning patterns and personal and contextual factors and academic performance. *Higher Education*, 49(3): 205-234.

Vernon, D. T. A., & Blake, R. L. (1993). Does problem-based learning work? A meta- analysis of evaluative research. *Academic Medicine*, 68(7): 550-563.

Virtanen, P. J., Kosunen, E. A. L., Holmberg-marttila, D. M. H., & Virjo, I. O. (1999). What happens in PBL tutorial sessions? Analysis of medical students' written accounts. *Medical Teacher*, 21:270–276.

Visschers-Pleijers, A. J. S. F. (2006). *Tutorial group discussion in problem-based learning: Studies on the measurement and nature of learning-oriented student interactions.*

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., Wolfhagen, H. A. P. , & van der Vleuten, C. P. M. (2003). *Development and validation of an instrument to identify learning-oriented group interactions in PBL*. Paper presented at the biennial conference of the European Association for Research in Learning and Instruction (EARLI), Padua, Italy.

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Student perspectives on learning-oriented interactions in the tutorial group. *Advances in Health Sciences Education*, 10(1): 23-35.

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., de Leng, B. A., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2006). Analysis of verbal interactions in tutorial groups: A process study. *Medical Education*, 40: 129-137.

Vye, N. J., Goldman, S. R., Voss, J. F., Hmelo, C., & Williams, S. (1997). Complex math problem-solving by individuals and dyads: When and why are two heads better than one? *Cognitive Instruction*, 15: 435–484.

Vygotsky, L. S. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Walker, A., Bridges, E., & Benjamin Chan, B. (1996). Wisdom gained, wisdom given: instituting PBL in a Chinese culture. *Journal of Educational Administration*, Vol. 34(5): 12 – 31.

Walker, A., & Leary, H. (2009). A Problem Based Learning Meta-Analysis: Differences Across Problem Types, Implementation Types, Disciplines, and Assessment Levels. Interdisciplinary *Journal of Problem-based Learning*, 3(1): 6-28.

Walton, H. (1997). Small group methods in medical teaching. *Medical Education*, 31:459–464.

Warburton, B., & Whitehouse, C. (1998). Students' perceptions of a learner-centred approach using problem-based learning on an undergraduate general practice course at the University of Manchester. *Medical Teacher*, 20(6):590-591.

Wetzel, D. R. (2008). Scientific Method and Problem Based Learning. Retrieved from Suite101 website: Suite101.com

Whelan, A. M., Mansour, S., & Farmer, P. (2002). Outcomes-Based Integrated Hybrid PBL Curriculum. *American Journal of Pharmaceutical Education*, 66(3): 302-311.

Wigen, K., Holen, A., & Ellingsen, O. (2003). Predicting academic success by group behaviour in PBL. Medical Teacher, 25(1): 32-37.

Wilkinson, T. J., Wells, J. E., & Bushnell, J. A. (2004). Are differences between graduates and undergraduates in a medical course due to age or prior degree?. *Medical Education*, 38: 1141-1146.

Wijnia, L., Loyens, S. M. M., & Derous, E. (2011). Investigating effects of problem-based versus lecture-based learning environments on student motivation. *Contemporary Educational Psychology*, 36: 101-113.

Williams, G., & Lau, A. (2004). Reform of undergraduate medical teaching in the United Kingdom: A triumph of evangelism over common sense. *British Medical Journal*, 329(7457): 92-94.

Williams, B. & Webb, V. (2013).Examining the measurement properties of the Interdisciplinary Education Perception Scale (IEPS) in paramedic education. *Nurse Education Today*, 33(9): 981–985.

Willis, S. C., Jones, A., Bundy, C., Burdett, K., Whitehouse, C. R., & O'Neill, P. A. (2002). Small-group work and assessment in a PBL curriculum: a qualitative and quantitative evaluation of students' perceptions of the process of working in small groups and its assessment. *Medical Teacher*, 24: 495–510.

Windschitl, M. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Review of Educational Research*, 72(2): 131–175.

Wood, D. F. (2003). ABC of learning and teaching in medicine: Problem based learning. *British Medical Journal*, 326(7384): 328-330.

Wood, D. F. (2008). Problem based learning: Time to stop arguing about the process and examine the outcomes. *British Medical Journal*, 336:971–971.

Woodward-Kron, R. & Remedios, L. (2007). Classroom discourse in problem-based learning classrooms in the health sciences. Australian Review of Applied Linguistics, 30 (1): 9.1–9.18.

Wun, Y. T. (2007). PBL curriculum improves medical students' participation in small-group tutorials. *Medical teacher*, 29(6): 198-203.

Wun, Y. T., Tse, E. Y. Y., Lam, T. P., & Lam, C. L. K. (2007). PBL curriculum improves medical students' participation in small-group tutorials. *Medical Teacher*, 29(6): e198-e203.

Yee, H. Y., Ammu, R., & Gnanajothy, P. (2006). Improving PBLs in the International Medical University: defining the "good" PBL facilitator. *Medical Teacher*, 28(6): 558–560.

Yeung, E., Au-Yeung, S., Chiu, T., Mok, N. & Lai, P. (1999) Application of problem based learning strategies to enhance clinical reasoning and self-directed learning skills in a university physiotherapy programme. In J. Marsh (Ed.) *Implementing Problem Based Learning Project: Proceedings of the First Asia Pacific Conference on Problem Based Learning* (pp. 95-110). Hong Kong: The University Grants Committee of Hong Kong, Teaching Development Project.

Zhang, Y, & Mi, Y. (2010). Another Look at the Language Difficulties of International Students. *Journal of Studies in International Education*, 14(4): 371-388.

Zimmerman, B J. (1990). Self-regulated learning and academic Achievement: An overview. *Educational Psychologist*, 25(1): 3-17.

CHAPTER 7

APPENDICES

Appendix 1.

Questionnaire

Please answer the following questions completely,

1) Gender:

a) Male

b) Female

2) Age:

a) 16-20

b) 20+

3) Educational level:

a) Completed year 12

b) Partially completed Bachelor's degree c) Completed Bachelor's degree

d) MSc. e) PhD

4) Year of study:

a) First year

b) Second year c) Third year

5) Is English your first language?

a) Yes

b) No

Criteria	Strongly agree	Agree	Disagree	Strongly disagree
I: Skills development				
1. I developed critical thinking skills through PBL tutorials				
2. I developed problem solving skills in PBL				
3. I developed the ability to think laterally in solving problems in PBL				
4. I have gained skills in making diagnosis in PBL				
5. PBL enhanced my communication skills				
II: Group process				
6. PBL tutorials promote team work				
7. The small group setting of PBL encourages the group to share their ideas				
8. Everyone in my PBL group contributes significantly to the discussion				
9. I like sharing my knowledge with my PBL group				
III: Learning preference				
10. I prefer PBL classes to didactic teaching such as lectures				
11. I learn better in a small group tutorial than in a large group lecture				
12. I understand difficult concepts better if they are discussed in PBL, rather than presented in a lecture				
IV: Tutor practice				
13. My tutor promotes a relaxed atmosphere in PBL tutorials				
14. My tutor asks lots of questions about the problem being solved				
15. My tutor uses questions to keep the group on track				
16. My tutor is good at resolving conflicts in the group				

Appendix 2.

BUHREC Protocol Number: RO-647

Dear Student,

A project titled "Effect of tutor behaviour on student performance in PBL tutorials" is being carried out in the Faculty of Health Sciences & Medicine at Bond University by Noura Alajmi, a PhD student in Health Education, under the supervision of Professor Debra Henly and Dr Christine Tom. This survey is being conducted for the purpose of research in the area of students' knowledge, attitudes and behaviours toward the Problem Based Learning (PBL) tutorial process, and forms an important part of this study.

Your participation will be of value in improving the PBL process. The responses to this questionnaire are anonymous and confidential. Thank you for your participation.

This survey has been approved by the Bond University Ethics Committee (Project Number RO-647).

Yours Sincerely, Student signature:

Noura Alajmi, Bs, Ms
Postgraduate student
Faculty of Health Sciences & Medicine
Bond University

Appendix 3.

Human Research Ethics Committee (BUHREC)

7 June 2007

Professor Debra Henly/Noura Alajmi
Faculty of Health Sciences and Medicine
Bond University

Dear Debra and Noura

Protocol No:	**R0647**
Project Title:	**Effect of tutor behaviour on student performance in PBL**

I am pleased to confirm that approval has been given by Bond University Human Research Ethics Committee to proceed with your project.

As part of BUHREC's role in monitoring research projects until completion, the Committee requires, as a condition of approval, that all investigations be carried out in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Research Involving Humans and Supplementary Notes. Specifically, approval is dependent upon your compliance, as the researcher, with the requirements set out in the National Statement as well as the research protocol and listed in the Declaration which you have signed.

Please be aware that the approval is given subject to the protocol of the study being under taken as described in your application. As you may be aware the ethics committee is required to annually report on the progress of research it has approved. We would greatly appreciate if you could advise us when you have completed data collection and when the study is completed

Should you have any queries or experience any problems, please liaise directly with Caroline Carstens early in your research project: Telephone: (07) 559 54194, Facsimile: (07) 559 51120, Email: buhrec@bond.edu.au.

We wish you well with your research project. Yours sincerely

Dr Mark Bahr

Chair

Appendix 4.

BUHREC Protocol Number: RO-860

Dear Student,

A project titled "Factors that influence Performance in a Problem-Based Learning Tutorial" is being carried out in the Faculty of Health Sciences & Medicine at Bond University by Noura Alajmi, a PhD student in Health Education, under the supervision of Professor Debra Henly and Dr Christine Tom. This project has been approved by bond University Human Research Committee.

As a part of this study, PBL tutorial sessions will be videotaped. This videotaping is being conducted for the purpose of research in the area of students' behaviours during the Problem Based Learning (PBL) tutorial process and the effects of this on student learning. This will form an important part of this study and will result in a better understanding of how PBL tutorials work.

If you agree to participate in this study, your PBL tutorial group will be videotaped twice; during a Monday and a Friday tutorial. You will not be identified to the researchers and will be known only by a unique identifier. I will not know your name, nor will I seek to find out who you are.

These videotapes will only be viewed by myself and my supervisors Dr Debra Henly and Dr Christine Tom. Videotapes will be destroyed at the end of the project. The information obtained from the videos will not be used for any purpose other than this research and will not in any way affect your results during your Medical studies.

As part of the project, I ask your permission to obtain your exam results and again, this will be given to me anonymously. I will not be able to match your identity to your exam results; the person who will supply your academic results to me will match these results to your unique identifier, I will never know your name. This information will enable me to match student performance during PBL"s with overall academic performance.

If you are willing to take part in this important study, please sign the declaration over the page.

Thank you for your participation. Yours Sincerely,

Student researcher	Principal investigator	Co-researcher
Noura Alajmi, Bs, Ms	Dr Debra Henly	Dr Christine Tom

I agree to take part voluntarily in the above Bond University research project "Factors that influence Performance in a Problem-Based Learning Tutorial". I have read and understand the above explanatory statement.

I am willing to:

- Be videotaped during the PBL tutorial sessions.
- Allow the researcher to have access to my examination results, which will be de- identified.

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or

to any other party.

I understand that I have the right to withdraw from the study at any time without any obligations. If I choose to withdraw, I will be placed in a different group for the week of the study. There will no adverse consequences if I decided not to participate or to withdraw from the study.

Name: …….(Please print)

Signature: ……...

Date: ……...

Appendix 5.

BUHREC Protocol Number: RO-860

Dear Tutor,

A project titled "Factors that influence Performance in a Problem-Based Learning Tutorial" is being carried out in the Faculty of Health Sciences & Medicine at Bond University by Noura Alajmi, a PhD student in Health Education, under the supervision of Professor Debra Henly and Dr Christine Tom. This project has been approved by Bond University Human Research Ethics Committee.

As a part of this study, PBL tutorial sessions will be videotaped. This videotaping is being conducted for the purpose of research in the area of students' behaviours during the Problem Based Learning (PBL) tutorial process and the effects of this on student learning. This will form an important part of this study and will result in a better understanding of how PBL tutorials work.

If you agree to participate in this study, your PBL tutorial group will be videotaped twice; during a Monday and a Friday tutorial. You will not be identified to the researchers and will be known only by a unique identifier. I will not know your name, nor will I seek to find out who you are.

These videotapes will only be viewed by myself and my supervisors Dr Debra Henly and Dr Christine Tom. Videotapes will be destroyed at the end of the project. The information obtained from the videos will not be used for any purpose other than this research.

If you are willing to take part in this important study, please sign the declaration over the page.

Thank you for your participation. Yours Sincerely,

Student researcher	Principal investigator	Co-researcher
Noura Alajmi, Bs, Ms	Dr Debra Henly	Dr Christine Tom

I agree to take part in the above Bond University research project “Factors that influence Performance in a Problem-Based Learning Tutorial”. I have read and understand the above explanatory statement.

I am willing to:

- Be videotaped during the PBL tutorial sessions.

I understand that I have the right to withdraw from the study at any time without any obligations.

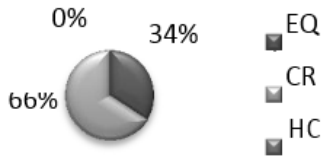
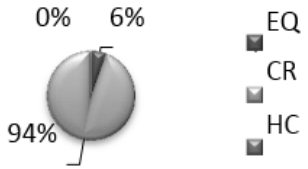
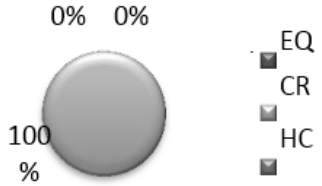
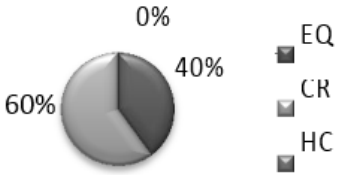
Name: …… (Please print)

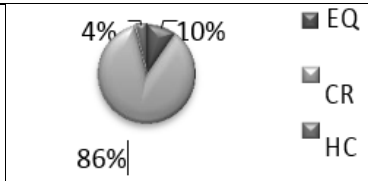
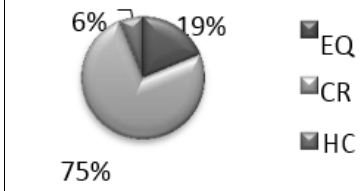
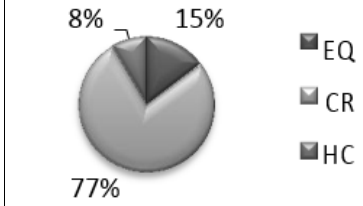
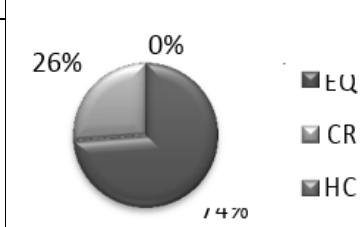
Signature: ……...

Date: ……

Appendix 6.

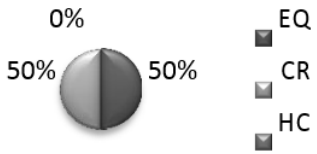
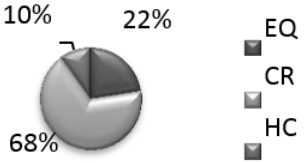
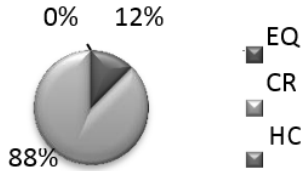
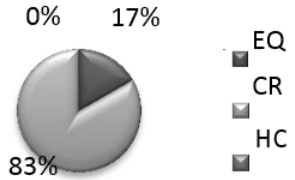
Table 1: Year 1-Group 1, Students demographics and their learning-oriented utterances: Exploratory questions (EQ), Cumulative reasoning (CR), and Handling conflicts (HC) in addition to their final grades and the descriptive documentation when analysing the recorded tutorials

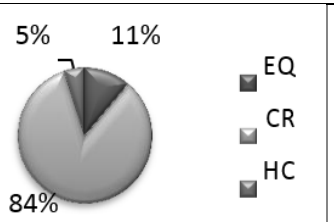
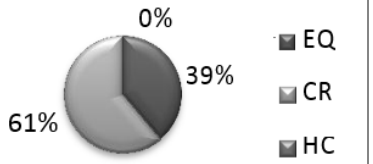
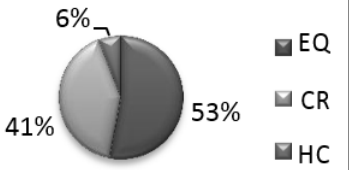
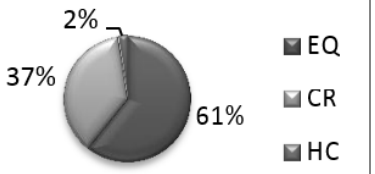
Student	Mean Of Utterances	Final grades	Percentages of students utterances and tutor utterances	Descriptive analysis
F1A1ED1ENG	0.52	83.15		Presented general arguments most of the time and engaged in the discussion carried out in the PBL tutorial. Moreover she seemed hesitant when directing her questions to the dominant students. Needed verification of her knowledge most of the time and mostly retained it from the two dominant students rather than the tutor.
F2A2ED2ENG	0.20	80.67		Presented some general arguments but without explanation or providing reasons. Additionally she directed her open and critical questions to the dominant students
F3A2ED2ENG	0.02	76.51		As it appeared that this student scored an optimum score in her cumulative reasoning oriented learning tasks but this was not the case of her real engagement and contribution in the tutorial as she only presented two general arguments as a response to the tutors inquiry as he was trying to engage her in learning oriented tasks. This student was quite most of the tutorial time.
M1A2ED2N-ENG	0.57	73.78		He was a dominant contributor. He presented most of the general arguments with reasons and explanations. Additionally students directed most of their exploratory questions to him. In addition to that he directed his arguments and his critical questions to the other dominant students but not to his peers or the tutor.

F4A1ED1ENG	0.22	73.83		This student was actively engaged and built positively but uncritically on what her peers were presenting. She directed most of her critical and open questions to the tutor. Had difficulty pronouncing some of the scientific terms.
M2A2ED2ENG	0.18	68.43		This student contradicted twice to the knowledge presented and explained his disagreement. Moreover he directed his open and critical questions to the two dominant students rather than the tutor or his other peers.
M3A2ED1ENG	1.06	68.11		He was a dominant member in the tutorial and was always forcing his new knowledge to the group. Moreover he was prevailing any discussion carried out and was mostly directing his general arguments to the other dominant student. He answered the questions that he received from his peers. At one occasion he ridiculed one of his peers knowledge. He contradicted some of the general arguments presented by his peers and gave an explanation to some of the contradictory information.
Tutor/MA2ED2ENG	1.61	----		The tutor attempted to ask open and critical questions relevant to the case. Additionally he answered the questions directed to him and presented some of the general arguments. He also tried to encourage the withdrawn student to be engaged within the group discussion by asking her some open questions. The tutor advised one of the dominant students to allow his peers to participate in the discussion and to give the other students in his group the opportunity to contribute by not presenting and forcing his knowledge to the discussion but that student did not follow the advice.

Note: F1A1ED1ENG= Female#1 in group, Age 1 (16-20 yrs.), ED 1(School-leavers), ENG=English language background; M3A2ED2N-ENG= Male#3 in group, Age 2 (20+ yrs.), ED 2(Graduate), N-ENG=Non-English language background. Grades in descending order for each group.

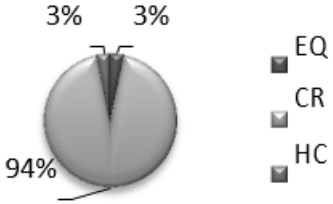
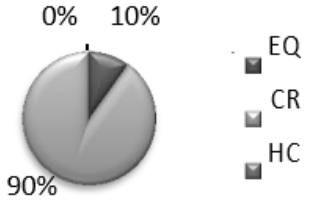
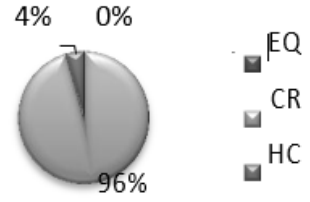
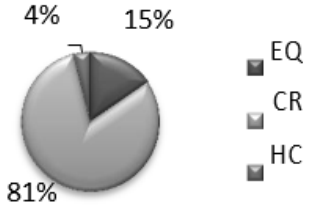
Table 2: Year 1-Group 2, Students demographics and their learning-oriented utterances: Exploratory questions (EQ), Cumulative reasoning (CR), and Handling conflicts (HC) in addition to their final grades and the descriptive documentation when analysing the recorded PBL tutorials

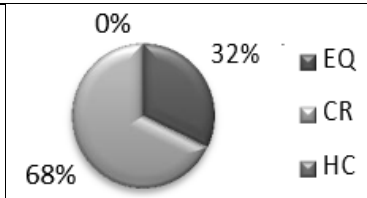
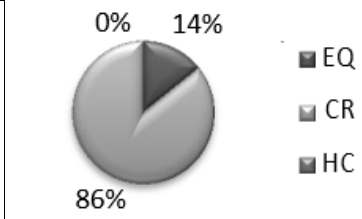
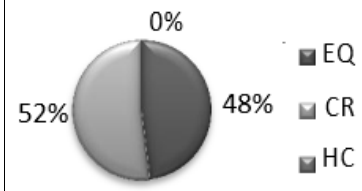
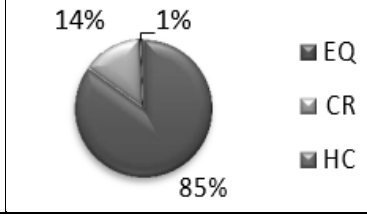
Student	Mean of utterances	Final grades	Percentages of students utterances and tutor utterances	Descriptive analysis
M1A1ED1ENG	0.27	85.34		The student was actively engaged critically and constructively and presented most of the general arguments.
F1A1ED1ENG	1.23	84.25		She involved mostly in building positively on her peers knowledge and explored through the arguments presented by engaging critically and constructively. Moreover she contradicted to some of the knowledge presented explaining her disagreement.
F2A1ED1ENG	0.09	76.33		Presented most of the general arguments but did not explain these arguments and asked many critical and open questions and directed them to the tutor only.
M2A2ED2N - ENG	0.20	70.71		Was actively engaged and dominated the discussion. Moreover, he was reading most of the time from a book that he attained through the session.

M3A1ED1N - ENG	0.89	68.51		He was actively engages in presenting the general arguments and trying to explain some of them to his peers. He used the net mostly as a resource for most of him and his peers' queries.
F3A2ED2N - ENG	0.20	61.99		He engaged sometimes by directing his open and critical questions towards the tutor only while he mostly presented general arguments and built positively but uncritically on his peers knowledge.
F4A2ED2ENG	0.19	61.81		She was not active at the first part of the PBL session but then became engages and asked many open and critical questions directed to the tutor. Moreover she started engaging positively and started building on her peers knowledge.
Tutor/FA2ED2 ENG	1.36	---------		Attempted to motivate the group when the group members seemed quite by asking open and critical questions. The technique used for asking the question was through providing the general arguments and then deriving question from them.

Note: F1A1ED1ENG= Female#1 in group, Age 1 (16-20 yrs.), ED 1(School-leavers), ENG=English language background; M3A2ED2N-ENG= Male#3 in group, Age 2 (20+ yrs.), ED 2(Graduate), N-ENG=Non-English language background. Grades in descending order for each group.

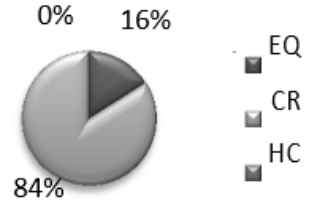
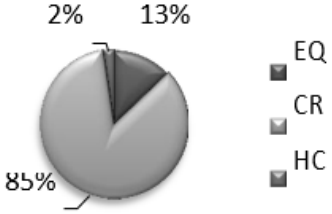
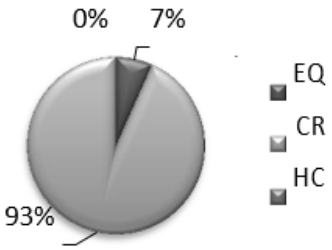
Table 3: Year 2-Group 1, Students demographics and their learning-oriented utterances: Exploratory questions (EQ), Cumulative reasoning (CR), and Handling conflicts (HC) in addition to their final grades and the descriptive documentation when analysing the recorded tutorials

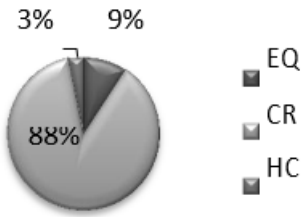
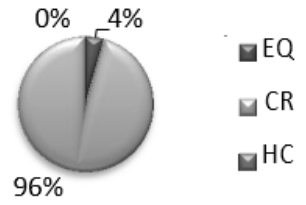
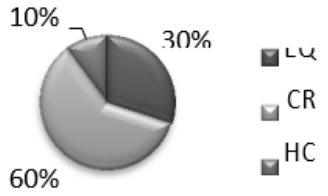
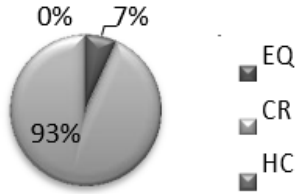
Student	Mean of utterances	Final grades	Percentages of students utterances and tutor utterances	Descriptive analysis
F1A2ED2ENG	0.34	76.00		Engaged positively in the group discussion by presenting most of the general arguments. Few open and critical questions were directed to the tutor.
F2A2ED2ENG	0.33	74.31		Presented general arguments and provided reasons for some of them. Directed her open and critical questions toward the chair person.
M1A2ED2ENG	0.51	71.00		Engaged positively but uncritically in the group discussion and directed most of his questions to the chair person and some to the tutor.
M2A2ED2ENG	0.29	67.00		Contradicted to some of the general arguments presented without explaining his disagreement. He sometimes engaged critically but constructively and asked open and critical questions relevant to the case.

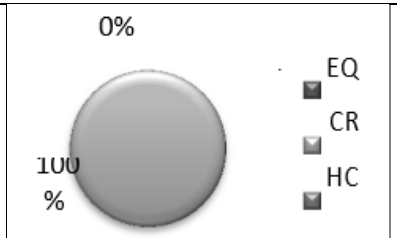
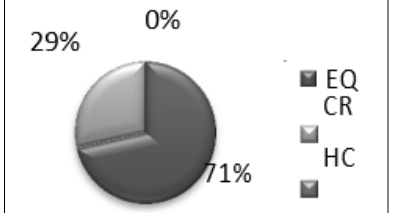
M3A2ED2N - ENG	0.31	66.50		Presented arguments and explained most of them to his peers. He was engaged constructively in higher order thinking and asked many questions relevant to the case.
F3A2ED2ENG	0.39	66.00		She only had eye contact with her tutor and with the student sitting beside her who was the chair person. She seemed quite but she engaged mostly in a positive and uncritical thinking and built on the ideas that were put forward by her peers. She occasionally asked open and critical questions
F4A2ED2N - ENG	0.86	62.50		She was assigned to be the chair person of this group. Managed the roles of the other students. Many times the tutor had to intervene and remind her of her role specially when a conflicting discussion takes more time than usual. She presented general arguments and attempted to explain and answer many of the questions directed to her from her peers. On the other hand she asked few questions that were mostly directed to the tutor.
Tutor/FA2ED2 ENG	1.40	----		The tutor intervened mostly when the group is silent or when the chair person is not performing her duties properly. She asked open and critical questions. She seemed relaxed though the tutorial process.

Note: F1A1ED1ENG= Female#1 in group, Age 1 (16-20 yrs.), ED 1(School-leavers), ENG=English language background; M3A2ED2N-ENG= Male#3 in group, Age 2 (20+ yrs.), ED 2(Graduate), N-ENG=Non-English language background. Grades in descending order for each group.

Table 4: Year 2-Group 2, Students demographics and their learning-oriented utterances: Exploratory questions (EQ), Cumulative reasoning (CR), and Handling conflicts (HC) in addition to their final grades and the descriptive documentation when analysing the recorded tutorials

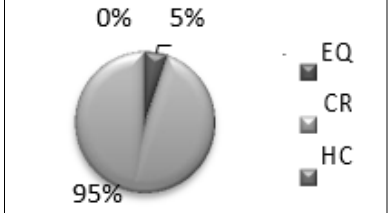
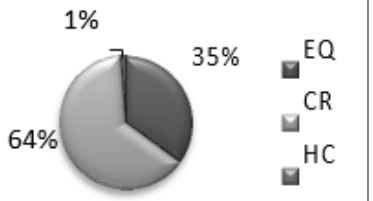
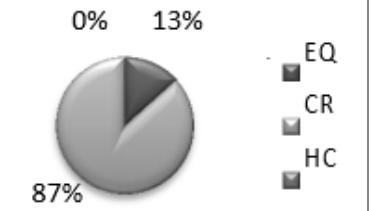
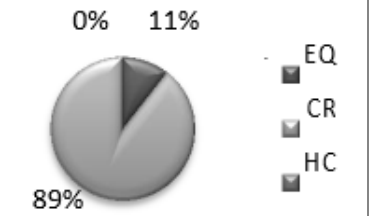
Student	Mean of utterances	Final grades	Percentages of students utterances and tutor utterances	Descriptive analysis
F1A1ED1N - ENG	0.28	79.00		She was actively engaged in the group discussion by building positively but uncritically on what her peers said. She mostly asked higher order questions directed to the tutor.
F2A1ED1ENG	0.96	76.50		She contradicted once to the knowledge presented by her peers and presented an explanation of her disagreement. Moreover she engaged in the group discussion by building positively but uncritically on what was presented by her peers. Asked open and critical questions occasionally.
M1A1ED1ENG	0.33	75.50		Performed most of the cumulative reasoning learning oriented tasks and built critically on but constructively on the others ideas and thoughts by asking higher order questions.

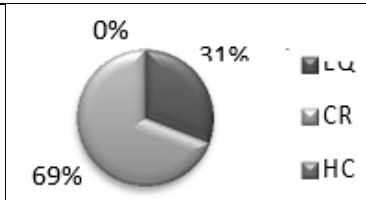
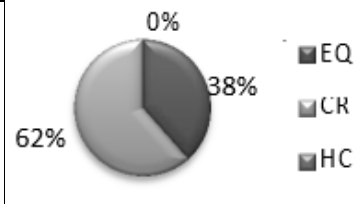
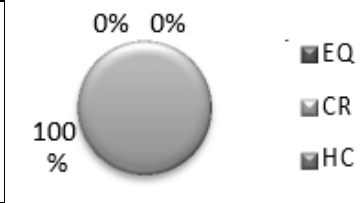
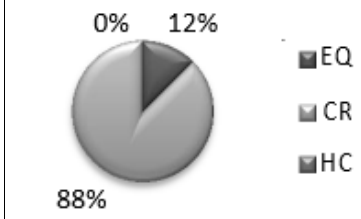
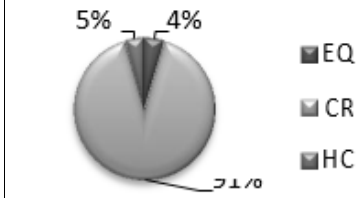
F3A2ED2ENG	1.06	68.50		Performed most of the cumulative reasoning learning oriented tasks and asked higher order questions relevant to the case and her questions were directed towards the tutor.
M2A2ED2ENG	0.26	67.50		Was quite but tried to engage in the group discussion by applying the cumulative reasoning tasks and asked only one open question and, was directed to the tutor.
F4A2ED2ENG	0.11	67.00		Presented general arguments and asked many critical and open questions and directed them to the tutor.
F5A2ED2ENG	0.36	64.00		She engaged mostly by building positively but uncritically on her peers thoughts and ideas. She asked 2 open questions and directed them to the tutor as she was considered the source of the general arguments.

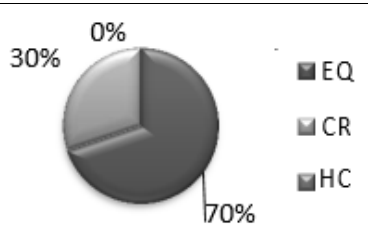
M3A2ED1N - ENG	0.08	60.50		Engaged only five times during the tutorial period and presented general arguments but did not ask any
Tutor/FA2ED2 ENG	2.77	--------		She asked most of pen and critical questions and engaged in the cumulative reasoning tasks. When she asked the students at the end of the session to summarise the case, none of them answered and all of them were waiting for her to present the summary.

Note: F1A1ED1ENG= Female#1 in group, Age 1 (16-20 yrs.), ED 1(School-leavers), ENG=English language background; M3A2ED2N-ENG= Male#3 in group, Age 2 (20+ yrs.), ED 2(Graduate), N-ENG=Non-English language background. Grades in descending order for each group.

Table 5: Year 2-Group 3, Students demographics and their learning-oriented utterances: Exploratory questions (EQ), Cumulative reasoning (CR), and Handling conflicts (HC) in addition to their final grades and the descriptive documentation when analysing the recorded tutorials

Student	Mean of utterances	Final grades	Percentages of students utterances and tutor utterances	Descriptive analysis
M1A1ED1N - ENG	0.66	81.50		Actively engaged and built positively upon his peers ideas and asked few open questions. Contradicted to the information presented by his peers but did not explain his argument.
F1A1ED1ENG	0.89	72.50		Engaged actively and provided most of the general arguments and explained some of them to her peers. Directed most of her critical questions to her tutor. Contradicted once to the information presented but she did not provide an explanation to her negation.
M2A1ED1ENG	0.17	69.50		Engaged in her groups learning oriented tasks about 12 times and asked two open questions. Provided a conclusive argument once. He seemed quite unless he wanted to present an argument.
F2A2ED2ENG	0.21	69.00		Was not very active and as her peer and she presented general arguments 13 times and asked her tutor 2 open questions.

F3A1ED1ENG	0.01	66.00		While she built positively on her peers ideas and presented general arguments, she asked more open and critical questions
F4A2ED2ENG	0.14	66.00		She carried out the cumulative reasoning learning oriented tasks less than her peers and asked few questions.
F5A2ED2ENG	0.12	66.00		She built on her peers ideas and thoughts about 11 times but did not ask any questions.
M3A1ED1ENG	0.36	65.00		He presented most of the general arguments and asked few open questions.
M4A2ED2ENG	0.24	63.50		He contradicted to the knowledge presented but did not explain his disagreement. Presented most of the general arguments. Asked the tutor only one open question

Tutor/FA2ED2 ENG	1.52	----------		Always attempted to motivate the students to present their general arguments and at the same time encouraged the quite ones to contribute to the discussion for instance a quite student was sitting beside her and she asked her to bring one of the available resources and read certain information needed for the discussion. Also gave that students a feedback to be involved more in the group activities.

Note: F1A1ED1ENG= Female#1 in group, Age 1 (16-20 yrs.), ED 1(School-leavers), ENG=English language background; M3A2ED2N-ENG= Male#3 in group, Age 2 (20+ yrs.), ED 2(Graduate), N-ENG=Non-English language background. Grades in descending order for each group.

APPENDIX 7.

18 September 2008

Prof Debra Henly/Dr Christine Tom/Noura Alajmi
Faculty of Health Sciences and Medicine
Bond University

Dear Debra, Christine and Noura

Protocol No: **RO860**

Project Title: **Factors that Influence Performance in a Problem Based Learning Tutorial**

Thank you for submitting the amendments as requested after a full review of your application. I am pleased to confirm that those amendments have been approved and you may now commence your research.

As a reminder, BUHREC's role is to monitor research projects until completion. The committee requires, as a condition of approval, that all investigations be carried out in accordance with the National Health and Medical Research Council's (NHMRC) National statement on Ethical Conduct in Research Involving Humans and Supplementary Notes. Specifically, approval is dependent upon your compliance, as the researcher, with the requirements set out in the National Statement as well as the research protocol and list in the Declaration which you have signed.

Please be aware that the approval is given subject to the protocol of the study being under taken as described in your application with amendments. As you may be aware the ethics committee is required to annually report on the progress of research it has approved. We would greatly appreciate if you could advise us when you have completed data collection and when the study is completed.

Should you have any queries or experience any problems, please liaise directly with Caroline Carstens early in you research project: Telephone: (07) 559-54194, Facsimile: (07) 559 51120, Email: buhrec@bond.edu.au.

We wish you will with your research project. Yours Sincerely

Dr Mark Bahr
Chair