UNIVERSITY OF SOUTHERN QUEENSLAND

IMPLEMENTING PROBLEM-BASED LEARNING IN SOFTWARE ENGINEERING IN A SRI LANKAN UNIVERSITY

A Dissertation submitted by

Deborah Macan Markar, B.Ed. (Hons), Grad Dip Comp, M Comp Studies,

For the award of

Doctor of Philosophy

2010

Abstract

The study aims to identify the parameters of an optimal learning environment to promote the development of graduate attributes and higher order learning skills in the context of a professional preparation course for Information Technology graduates at a public university in Sri Lanka. It employs a design-based learning approach with iterations of the design being undertaken over a four year period. The underlying pedagogy for the design was problem-based learning. As students were unused to being challenged to apply their knowledge to the resolution of problems, a primary focus of the design was on scaffolding the learning experience. Significant use was made of eLearning tools available through the Moodle content management system for this purpose. In addition to this, course lectures were supplemented with tutorial sessions which provided lecturers with an opportunity to work through a series of skills building activities with the students. A key initiative was to enhance student exposure to industry through the use of videos, chat and discussion forums as well as through face-to-face meetings. As many students in the public university system come from the rural hinterland of Sri Lanka their experience of the industry they aspire to join is often minimal. One consequence of this is a lack of awareness of the importance of soft skills or graduate attributes to industry employers and a consequent lack of motivation to participate in learning activities directed toward building such skills. The study also identified a fundamental need to address the issues of general and cognitive academic language proficiency in English – the language of instruction. While a range of tools and approaches were used successfully to help students develop teamwork, communication, independent learning and problem-solving skills, it became clear that it was not realistic to target development of such skills within a single subject and without addressing the issue of English language proficiency first. As the approach to study was a departure from largely didactic teaching-learning styles to which students had previously been exposed, opportunities for them to reflect on their learning were essential. These were built into the course in the form of assessable assignments. The study concludes by recommending a whole-of-curriculum approach in the form of a framework for a further and more extensive trial of the approach.

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

______________________________ ____________________

Signature of Candidate Date

ENDORSEMENT

______________________________ ____________________

Signature of Supervisor Date

ACKNOWLEDGEMENTS

I would like to acknowledge the support of the academic and non-academic staff of the University of Moratuwa, Sri Lanka without whom this research would not have been possible. The Faculty of Information Technology generously allowed me full and unrestricted access to students and staff and supported me at every step from adopting the Moodle™ Content Management System for all courses to providing transport to allow students to attend focus group sessions. FIT have given their consent to disclose the results of this study in full in this thesis report. To the students of the Faculty of Information Technology who selflessly gave of their time and energy to provide feedback and improve their course for future students, I wish you well in all of your future endeavours and thank you for your support and cooperation.

I would also like to thank the Faculty of Engineering and Surveying at the University of Southern Queensland, Australia, for their time and support in shaping this research from its inception. In particular, I would like to acknowledge the contributions of Mrs. Lynn Brodie and Dr. Mark Porter. Similarly, I would like to acknowledge the contributions of the PBL unit at Temasek Polytechnic, Singapore.

Finally I would like to thank my supervisors, Dr. Jerry Maroulis (University of Southern Queensland) and Dr. Ajith Madurapperuma (University of Moratuwa) for their support and guidance. I would also like to thank Prof. James Cameron of the Northern Territory University for reading and providing feedback on the penultimate draft of this thesis.

Mr Gradgrind … in Charles Dickens' book “Hard Times” saw his pupils as ‘...little vessels, there and then arranged in order, ready to have imperial gallons of facts poured into them until they were full to the brim’ (Dixon 2000, p.38).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

1.1 The Research Setting

The evolution of education systems is a challenging process encountering resistance at every turn. This is no less true in Sri Lankan than anywhere else. In the tertiary sector, resistance to change comes from stakeholders at all levels - from senior academic staff who have made their way to the top in a system they understand well and from students who have gained entry to the precious few seats available in universities after a lifetime of competition in primary and secondary schools where the didactic teacher-centered learning environment mirrors that of the universities.

The introduction of new technology into education systems can be an opportunity to do the same things that have always been done more efficiently or more cost-effectively or it can be an opportunity to overcome resistance and bring about change. This thesis is a report of a study which attempted to use the introduction of a content management system (CMS) built around a constructivist approach to learning (Moodle™) to a traditional university context to usher in a change in pedagogy. The study, conducted between 2004 and 2007, looks at the impact of introducing the new pedagogy.

The research base was the Faculty of Information Technology (FIT) within the University of Moratuwa near Colombo. Sri Lanka has a total of 17 public universities of which the University of Moratuwa is regarded by many as the premier technical university. Moratuwa has traditionally had Faculties of Engineering and Architecture. Students enrolling in the BSc (Engineering) can elect to specialize in Computing. In June 2001, the university established the Faculty of Information Technology to help meet the unsatisfied demand for IT professionals in the country.

1.1.1 Student Profile – Faculty of Information Technology (FIT), University of Moratuwa

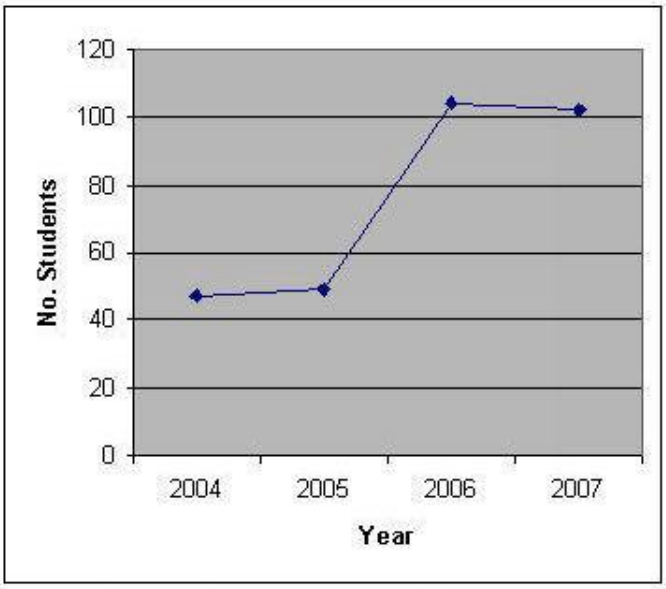


Figure 1.1 : Enrolment levels of 2nd year FIT students 2004-2007

Students participating in this study were in their second year of the three-year B.Sc. offered through FIT. During the period of the study, 47 students were enrolled in second year in 2004, 49 in 2005, 104 in 2006[1] and 102 in 2007 (Fig. 1.1). Of those enrolled roughly 75% were male and 25% female. These proportions remained constant over the course of the study. The ethnic breakdown of the 2004/2005 groups were around 75% Sinhala, 20% Tamil and 5% Muslim but by 2007, with the escalation of the civil war, the numbers of Tamil students fell so that the proportions were close to 85% Sinhala, 10% Tamil and 5% Muslim. Many students come from outside Colombo and most have been educated in their mother tongue (Sinhala or Tamil) and attended single sex schools.[2] In contrast, the language of instruction at the University of Moratuwa is English and the university is co-educational. In Sri Lanka, students follow the General Certificate in Education (G.C.E.) studying to sit their G.C.E. Ordinary Level (O/L) examinations at the end of year 11. Those who pass the O/L examination and wish to go onto tertiary study, must take an additional two years (grades 12 and 13) to sit for the Advanced Level (A/L) examination. Students in second year of university are usually around 22 years of age because of delays experienced in making the move from school to university.[3]

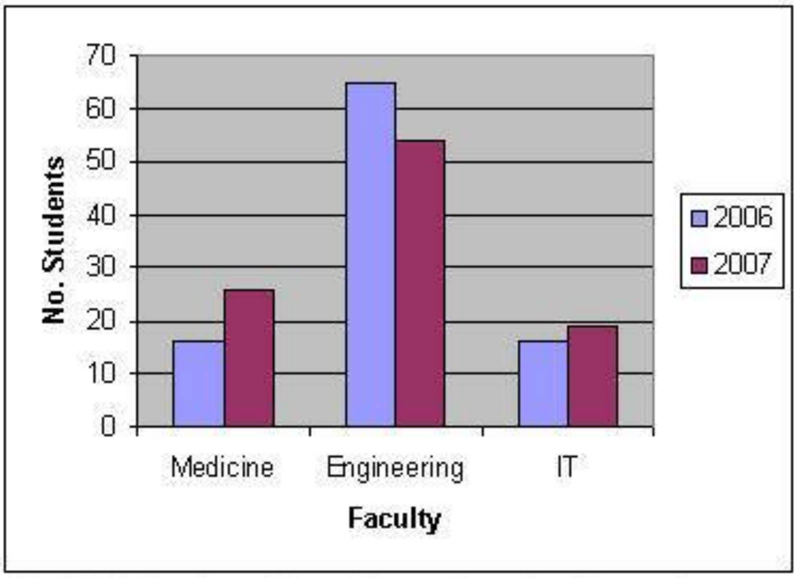


Figure 1.2 : FIT students first preference for university enrolment in 2006-2007

In most cases, IT was a second or third preference when seeking university entrance (Fig. 1.2); most FIT enrolees would have preferred to have studied Engineering if their marks had supported it.[4] Few had any formal study of computing at school

[1] This sudden doubling of the enrolment was imposed on the faculty by the University Grants Commission who were under political pressure to provide more tertiary opportunities for high school graduates.

[2] Of the 78 students responding to the 2007 course feedback survey, 87% said that they had been educated in Sinhala, 13% in Tamil and none in English. 68% had attended single sex schools.

[3] To get a good A/L pass, many students repeat their A levels (up to a legal maximum of 3 times). There are also delays of up to a year while they wait for their A/L examination results and their university applications to be processed.

[4] Only 16% of the 82 students responding to the 2006 course feedback survey said that IT was their first choice of university course. 65% said that they had nominated Engineering as their first preference and 16% said that they had nominated Medicine. More students from the 2007 batch had preferred Medicine (26%) than Engineering (54%) but a similarly low percentage had marked IT as their first choice (19%).

although some had undertaken short courses with private providers after leaving school and while waiting for university entrance.[5]

1.2 Rationale for the Research

From its inception, FIT has embraced its role of training young professionals for industry by working closely with local employers in the Information and Communications Technology (ICT) industry. Through this close association the faculty became aware that, although University of Moratuwa graduates are highly sought after by industry, employers often expressed disappointment with their lack of "soft" skills such as teamwork, problem-solving and communication skills and a lack of commitment to ongoing independent learning. These issues, described in more detail in Chapter 3, are often mentioned and cited in studies conducted by national industry bodies (SLICTA 2005; CSSL 2000/2001). The same can be said of IT graduates from the public university sector in general (CSSL 2000/2001).

At the time that this research study was initially proposed, the Dean and faculty staff were exploring ways to address these deficiencies and to improve the overall learning environment for students. Faculty staff had recognized the potential of eLearning technologies to create supportive learning environments for their students and so many had taken the initiative to make lecture notes and past examination papers available online. However this did not address the underlying pedagogical issues nor did it address the concerns about poor soft skills development. In a workshop organized by the US National Academy of Sciences in June 2000, Harvard University professor Christopher Dede noted a similar tendency internationally commenting that while many educators had, until recently, viewed IT primarily as a way to increase student access and provide economies of scale for traditional modes of education, IT has the power to do more, namely to 'transform education by supporting shared creation, collaboration, and mastery of knowledge' (Dede 2000 in Hilton 2002, p.3). He went on to say, 'IT is powerful only if the medium is used well' (Dede 2000 in Hilton 2002, p.3) and concluded that 'in the pedagogy lies the power' (Dede 2000 in Hilton 2002, p.3).

1.2.1 Pedagogical Issues

At Moratuwa University, a traditional educational model was used based on lectures (as a vehicle to transfer knowledge from lecturer to students) and lab sessions (where students had the opportunity to practice elements of programming taught in lecture sessions) with examinations being largely a test of the student's ability to recall the content conveyed in the lectures. From its inception in 2001, FIT has taken steps to nurture the development of higher order learning skills by including project units at each year level of the syllabus. However, the full potential of these project subjects has not been fully realized and faculty lecturers were concerned about the propensity of the student body to simply rote learn for exams and to plagiarize the Internet and other sources in the production of assignments.

Students themselves, when surveyed prior to the start of the study (refer to Chapter 3), felt that much of what they did at university was geared to rote learning and

[5] In response to a Student Course Experience Questionnaire administered in 2006, some 60% of students indicated that they had undertaken short courses in computing after completing school. These were usually introductory Microsoft Office or programming courses. Less than 10% reported that they had had any exposure to computers at school. The situation was better for the 2007 batch with some 35% reporting that they had used computers during their A/Ls, mostly in informal electives.

passing content laden end-of-semester examinations. This was particularly the case for the more conceptual or less practical subjects.

Students received no specific training to develop the necessary soft skills demanded by industry but instead were expected to develop teamwork, problem-solving and communication skills through the experience of working in groups to do assignments and through following lectures and giving class presentations in English (refer to Chapter 3). Group work was encouraged in principle and was mandatory for the project subjects although, prior to this study, no direct training was given on how to work productively in a group or team.

1.2.2 Problem-based Learning (PBL)

A review of the literature (refer to Chapter 4) suggested that Problem-Based Learning (PBL), an approach to professional education used widely across the world (Barg et al. 1999; Dirckinck-Holmfeld 2009; Savin-Baden 2004), would have great potential to assist students to develop the soft skills desired by industry while also providing an environment within which higher order learning skills and analytical/problem-solving skills could be nurtured.

The term Problem-Based Learning (PBL) was originally coined by Don Woods, based on his work with Chemistry students in McMaster's University in Canada. However, the popularity and subsequent worldwide spread of PBL is mostly linked to the introduction of this educational method at the Medical School of McMaster University in the end of 1960s (Dirckinck-Holmfeld 2009).

Brodie (2007, p. 32) draws on the work of Mayo et al. to describe PBL as 'a pedagogical strategy where students are presented with open ended, contextualised, real world situations. They develop content knowledge, application of knowledge and problem solving skills by defining the problem, sourcing resources (including prior knowledge and experience of team members) and identifying gaps in their own knowledge'. She further draws on the work of Wilkerson & Gijselaers and that of Brodeur et al. to claim that, 'PBL is now a widespread teaching method in disciplines where students must learn to apply knowledge, not just acquire it' (Brodie 2007, p.32).

PBL is a teaching-learning methodology that reflects a constructivist pedagogy (Bichelmeyer & Hsu 1999; Savery & Duffy in Bentley et al. 1999) and, as such, can be argued to be more suited to information technology (IT) education than behaviourist approaches which focus on identifying a body of knowledge to be taught and instructional techniques to assist the learner to acquire that knowledge (Bichelmeyer & Hsu 1999). Knowledge in the field of IT is characterised by rapid obsolescence (Bentley 1999; Kirsch 1996; McCracken & Waters 1999). In such an environment, learning how to learn becomes more important than acquiring specific knowledge which may soon be out of date. Constructivist pedagogies such as PBL which emphasise metacognition (Barg et al. 1999; Bichelmeyer & Hsu 1999) as well as mastery of subject knowledge are more appropriate.

Bentley (1999, p. 70) cites a working group report by Ellis et al which suggests that 'PBL suits the Information Systems (IS) and computing fields as:

- IS and computing are, for the most part, problem driven;
- Life-long learning is necessary due to the rapidly and continually changing nature of the industry;

- Practitioners must constantly update their skills and competencies in order to keep abreast of new technology;
- The project group is the predominant mode of operation within the industry;
- IS and computing cross discipline boundaries'.

This analysis is particularly relevant to the area of Software Engineering which focuses on finding IT solutions for organizations. This point is elaborating in Section 1.2.2.2 below.

The outcomes ascribed to PBL such as improved communication, independent learning, critical thinking, collaboration and teamwork skills, increased confidence, and increasing readiness to take responsibility for one's own learning (Aldred et al. 1997; Bentley et al. 1999; Kabir & Nelson 2007; Madden et al. 2007; Nuradhi & Kiswandono 2007) also suggest that a PBL approach would help students develop the graduate attributes targeted in this study.

Currently, the label of PBL is used 'to cover an amazing diversity of educational practices such as problem-solving learning, case-based learning, enquiry-based learning, problem-oriented learning, and action learning' (Dirckinck-Holmfeld 2009, p.4). While there is some debate in the literature as to what truly constitutes PBL, Dirckinck-Holmfeld (2009, p.4) maintains that 'the various PBL models all share a focus on learning through investigating real world problems rather than traditional subject based teaching, and student centred learning approaches'. This is the concept of PBL adopted in the current study. The theory of situated cognition suggests that knowledge gained through the investigation of real world and open problems can more readily be applied to the resolution of new and different problems than conceptual content transferred without a meaningful context (O'Donnell 1999) and it is this problem solving skill which software engineers require.

1.2.2.1 PBL at FIT

Despite the potential value of PBL, it is not an approach used in Sri Lanka outside some medical faculties (Khoo 2003). It was not until the Dean (my Associate Supervisor) had the opportunity to observe PBL learning environments first hand that he became convinced that a PBL approach might well be the answer for FIT. This opportunity arose on a trip to Australia to meet University of Southern Queensland staff in 2004. In Singapore, he was able to meet with the staff of Temasek Polytechnic who have been using a problem-based learning approach across all faculties since 1999 and who are regarded as a centre of excellence in the field[6] in Singapore, hosting annual conferences, publishing books and articles on the subject, and conducting a range of training programs. At USQ, the Faculty of Engineering and Surveying, also an award-winning[7] faculty for PBL, was very supportive allowing us to observe PBL sessions first hand and to speak to a number of lecturers about their personal experience with the PBL approach.

[6] Temasek Polytechnic received The Enterprise Challenge Shield from the Prime Minister's Office in Singapore for successfully bringing to fruition the development of a Problem-based Learning Education Model. The award recognizes the project which has contributed the highest new value to the Public Service.

[7] In 2007, the USQ Engineering Problem Solving Strand team won an Australian national award for Innovation in Curricula, Learning and Teaching from the Carrick Institute for Learning and Teaching in Higher Education.

The following is an excerpt from an interview with the Dean of FIT after this visit and in the first year of the study,

> We have done some research on different learning methodologies and we have started looking at a learning methodology called Problem-Based Learning where the students are guided, rather than taught, how to solve problems. Problems that are very much real life problems, where they have to learn how to work in teams, they have to learn how to gather the knowledge and resources required and put all these things together to solve the problem and also then, to present this solved problem in a professional way. By trying to do this, we not only want them to learn the subject content because the industry is generally happy about the subject knowledge of these graduates when they go out. But the problem that we have is not in the subject knowledge but in how to use this subject in a real development environment.
>
> (Dean FIT, Academic Staff Interview 2005)

Although it was anticipated that the highly traditional university culture, evident in the attitudes and expectations of both lecturing staff and students, might pose significant challenges to the introduction of a new pedagogy, the Dean and I were optimistic that, if we were able to provide a 'proof of concept' through piloting a PBL approach successfully - initially in a single subject area - we would be able to win support for changes to the learning environment of a wider scope, eventually integrating the approach across the syllabus.

> From the first year we will introduce this new learning environment, the problem-based learning environment, but very slowly because we don't want to try to make a drastic change and fail because we are going against traditionally established system that span years and years of getting use to a lecturer coming and giving lecture notes and then going for an exam that is based on the lectures that are given. So we don't want to drastically change this but slowly introduce, little-by-little, this environment where the students will learn for themselves what they have to learn, with our support. Of course we will give them guidance, we will give them resources, but they will take charge of their learning process and this is extremely important in a subject like ours which changes day by day.
>
> (Dean FIT, Academic Staff Interview 2005)

1.2.2.2 Introduction of PBL: FIT's starting point

It was thus decided to introduce PBL initially into the *Software Engineering* course, a second year, first semester subject. *Software Engineering* was a logical starting point since software engineers are the problem solvers of the IT industry. They usually work in teams, often comprising representatives of both the business and the IT side of an organisation. In these teams, it is usually the Software Engineers and Project Managers who interface with the client and, as such, communication skills are critically important. All members of the team lend their collective experience to the design and implementation of systems – each one unique with its unique set of problems to be solved. Hence Software Engineers are expected to have well developed problem-solving, teamwork and communication skills and, like everyone in the ICT industry, they need to work hard at keeping up with the rapid change which is the hallmark of the industry – lifelong independent learning skills.

1.2.2.3 eLearning Tools

While faculty initiatives to place lecture notes and past examination papers online were appreciated by students, it was apparent that a much higher level of student support could be provided through more extensive use of eLearning tools. Online technologies could be used to scaffold the PBL learning experience and help students to deal with the challenges of the new pedagogy. As such, the Dean felt that it would be beneficial to the faculty to use the PBL pilot to demonstrate the potential of such tools to academic staff. Consequently, the Moodle™ Content Management System was installed on the faculty server and student accounts established. Moodle was chosen because the constructivist philosophy behind its design matched the pedagogical philosophy of PBL.

1.3 Research Questions

Since PBL was being introduced to the faculty on a pilot basis,[8] close monitoring of its impact on student learning was imperative. However, I felt that the research needed to go beyond the simple monitoring and evaluation of a new initiative and gained the support of the Dean of FIT to pursue a program of research relevant to the PBL pilot. For instance, while PBL has been used successfully in professional education courses as diverse as engineering and education since the 1970s (Bichelmeyer & Hsu, 1999), I was wary of simply taking an approach from a western setting and using it without modification in the Sri Lankan context. In this instance, the advice of Dimmock (2000), working in Hong Kong is relevant,

> Questions arise about the relevance, applicability, validity and appropriateness of theories, perspectives and policies which are adopted and 'cloned' by education systems whose cultures and socio-political-economic contexts are quite dissimilar from those in which they were conceived…Western ideas and practices tend to prevail even in non-Western settings, a situation reinforced by the unquestioning assumptions made and the ready willingness on both the exporting and importing sides to regard theories, policies and practices as culturally neutral (Dimmock 2000, p.40).

Khoo (2003), started his paper with the question, "Can Asian medical schools and their students adapt to problem-based learning (PBL)?" which he then defends with the explanation, 'so far no one has questioned whether the outcomes expected of the learner in a PBL setting are applicable to students from different cultural upbringings … [and] the practice of PBL is premised on certain attitudes and characteristics of the learner that may not necessarily be applicable to medical students of different cultural backgrounds' (Khoo 2003, p.401).

Not only did I anticipate the need to modify or scaffold PBL approaches to suit the social culture of Sri Lanka and the organizational culture of the university, I also wanted to be able to understand the basis for any modifications that needed to be made. How could established learning theory together with my own understanding of the local context help me to understand more about which teaching-learning methods could be successfully transported and which could not? Would this newly found understanding help, in turn, to contribute to that same body of knowledge about learning theory?

In order to answer these questions, my research focuses on the impact of the educational context on the implementation of PBL in FIT.

Accordingly the research questions are,

1. How can a problem-based learning approach be implemented effectively in FIT to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills?

2. How can the lessons learnt from the experience be used to derive a theoretical framework which could be applied beyond the limited context of the study?

[8] The Dean of the Faculty applied to the University Senate for permission to implement the pilot in 2004.

1.4 Outline of the Thesis

Chapter 2 of this thesis will describe, in more detail, the design of the study implemented to answer these research questions. Chapter 3, will sketch out the background to the study – employer expectations, the learning environment and the background of the students participating in the study – all of which have been briefly described in this introduction. The initial design of the intervention was based on an understanding of the context derived from Chapter 3 and is described in Chapter 4. Chapters 5 – 7 follow the cycle of intervention, reflection and redesign that is the basis of the study, dealing with the results of implementing the design in 2005, 2006 and 2007 respectively and the impact that reflection on these findings had for changes to the design in the subsequent year. Chapter 7 discusses the final year of the study and looks at the trends emerging over the course of the research. Finally, Chapter 8 considers the implications of the findings in deriving a theoretical framework and a model for how this framework might be applied in other contexts.

CHAPTER 2

Study Design and Research Methodology

It is the intent of this study to explore in depth the application of PBL in a particular context in order to formulate a framework within which the approach can be later effectively scaled-up. As there is only limited research available on the implementation of PBL in similar contexts - either in Sri Lankan or South Asian generally - a design-based research approach was adopted to explore and refine the potential applicability of PBL. It is argued in the literature that design-based research is an approach particularly suited to educational research where there is a need to inform practice where such practice will always be situated in unique social contexts (Lagemann 2002; Barab & Squire 2004). The research questions themselves emphasize context and the need to understand the interplay between pedagogy, as represented by the designed intervention, and social context. In investigating these interactions, the study will not seek to control the variables which constitute the context but instead seek to describe and understand them. The designed intervention will be informed by existing learning theory. In turn, it is intended that the results of the study will contribute to a greater understanding of the underlying theory. Through an exploration of relevant, recent literature, this chapter will show how such aims and objectives are consistent with design-based research approaches.

In conducting the study, participants including lecturers, instructors and, to some extent, students were involved as co-participants. This chapter explains how such an approach is consistent with design-based research and the measures undertaken to be able to draw from this rich source of data without compromising the objectivity of the study.

2.1 Design-Based Research (DBR)

Yutdhana (2005) claims that, over the last decade, educators have come to realise that there is a gap between educational research and the problems and issues of everyday educational practice. She explains that, while much valuable research has been done using the methods or techniques of other disciplines, it is often difficult to translate these results into practice. Hence, what is required is a ‘new methodological approach guiding [researchers] to conducting research that speaks directly to practice’ (Yutdhana 2005, p.170). Lagemann (2002) concurs, arguing that the test of the value of educational research is whether, if acted upon, it is likely to achieve the desired result(s). She, like Yutdhana (2005), acknowledges the value of research that has been conducted using research methodologies borrowed from other disciplines but argues for new approaches specifically tailored for the needs of education. She posits that it is research which combines ‘knowledge of many sorts … thereby providing evidence about the chances of accomplishing one's goals, that should distinguish education research from other kinds of investigation. It is the capacity to predict outcomes from specific actions taken in practice that should set education research apart from other kinds of scientific inquiry’ (Lagemann 2002). She cites the American National Research Council as stating that,

> Education has its own set of features - not individually unique from other professional and disciplinary fields of study, but singular in their combination - that give rise to the

> specialization of education research. Among the features that make science in education different from science in other fields, none is more important than the fact that education varies constantly depending on the physical, social, cultural, economic, or historical environment (Lagemann 2002).

2.1.1 Emphasizing Context

According to Lagemann (2002), the key to generating educational research that speaks to practice lies in providing the practitioner, whose task it is to assess the applicability of the research to his/her own circumstances, with a detailed sketch of the context (physical, social, cultural, economic and historic) within which the research results were obtained and hence an idea of the extent to which the research results can be generalised to the practitioner's own context. This emphasis on the importance of context in educational research is the foundation of design-based research (DBR).

The DBRC (Design-Based Research Collective) state that 'design-based research methods are of value in addressing research questions related to the enactment of interventions in varying contexts' (DBRC 2003, p.8). Barab & Squire (2004, p.2) claim that design-based research offers the benefit of 'research results that consider the role of social context and have better potential for influencing educational practice, and creating tangible products, and programs that can be adopted elsewhere'.

In this study, the context is the Faculty of Information Technology (FIT) at the University of Moratuwa in Sri Lanka. Chapter 3 provides an introduction to this context by sketching the historical background to tertiary education in Sri Lanka highlighting factors which have had significant impact on the profile of FIT students and lecturers. It then goes on to describe the findings of a baseline survey conducted with students at the very beginning of the study before any intervention. These findings shed further light on the context while, at the same time, helping to set the parameters of the study. Data from the student survey is supplemented with excerpts from interviews conducted with academic staff in the first year of the study. Although the research was confined to a single faculty in a single university, it will be argued that the homogeneous nature of the public university system in Sri Lanka make it likely that the findings will have wider relevance. By describing the context in detail, this report seeks to provide evidence which will allow practitioners elsewhere in the Sri Lankan university system to decide whether the study is relevant to their own particular context.

2.1.2 Theory embodied as Design

'The term design-based research was first used in Hoadley (2002) to describe work combining software design and research in education' (Yutdhana 2005, p.170). Trialing teaching-learning methods and software tools has been at the heart of design-based research ever since.

> In education, this kind of research has been typically associated with the development of curricular products, teaching and learning methods or software tools (Collins 1992). At the core of such research is the development of an artifact for the purposes of improving teaching and learning (Gorard 2004, p.100).

The Design-Based Research Collective define design-based research as, 'an emerging paradigm for the study of learning in context through the systematic design and study of instructional strategies and tools' (DBRC 2003, p.5). Curricular products, teaching and learning methods and/or software tools are designed based on hypotheses about learning and how the teaching-learning environment in a particular context might be improved. Hence, whereas in other methodologies one might set out to test a hypothesis, DBR embodies the hypothesis in an artifact and sets out to test the validity of the artifact in the given context (DBRC 2003). Further, while other research approaches might seek to control environmental variables, DBR takes the stance that any educational context will be multi-variant and that the task of the researcher is not to control these variables but to describe the context in sufficient detail to allow an assessment of the extent to which the research results can be generalized (Barab & Squire 2004; Hoadley 2004).

2.1.3 Contributing to the Theory Base

Design-based researchers endeavour to promote understanding and further development of educational theory by testing how different pedagogical approaches / methods / tools work or fail in different contexts. Collins et al. (2004, p.19) state that, 'Design research is not aimed simply at refining practice. It should also address theoretical questions and issues if it is to be effective'. In the current study, I was interested in understanding how a PBL approach might be implemented successfully given the challenges of the educational context within FIT but also given the opportunity to significantly scaffold the approach with appropriate educational technologies. However, beyond creating an educational product to support the teaching-learning process in a particular context, I also wanted to be able to understand the outcomes of implementing the approach in terms of established educational theory and, if appropriate, to be able to go beyond this to positing a model for professional education and skills training which might be of use in the wider context of Sri Lankan undergraduate education.

This focus of the study on understanding and explaining the results in terms of learning theory and indeed contributing, in turn, to learning theory is again consistent with DBR approaches.

> Importantly, design-based research goes beyond merely designing and testing particular interventions. Interventions embody specific theoretical claims about teaching and learning, and reflect a commitment to understanding the relationships between theory, design artifacts, and practice…The intention of design-based research in education is to inquire more broadly into the nature of learning in a complex system and to refine generative or predictive theories of learning. Models of successful innovation can be generated through such work - models, rather than particular artifacts or programs, are the goal (Brown & Campione in DBRC 2003, p.6-7).

and

> [I]nstructional designs materially embody theoretical conjectures about how people learn. They therefore carry expectations about how designs should function in a setting, and tracing how such expectations are met or unmet can refine the underlying theoretical conjecture (Sandoval & Bell 2004, p.200).

In summary, in the design-based research tradition, this study focuses on the design of a teaching-learning strategy and education technology tools based on established theory but with the expectation that testing how these tools and strategies work or do not work in the selected context will support generating a theoretical framework of relevance.

2.2 Methodology

Gorard (2004, p.102) describes the steps of DBR as follows,

> [C]urrently accepted theory is used to develop an educational artifact or intervention that is tested, modified, retested and redesigned in both the laboratory and the classroom, until a version is developed that both achieves the educational aims

required for the classroom context, and allows reflection on the educational processes involved in attaining those aims.

Consistent with this explanation of DBR, the current study adopted an iterative approach over a period of four years with the goal of perfecting an educational artifact for teaching Software Engineering – a second year subject in the FIT BSc syllabus. The artifact comprised a work plan, student exercises and assignments, and a supporting set of eLearning tools. The specifics of each phase of the program are presented in Table 2.1.

Table 2.1: Phases of the Study Program

2004	Collection of baseline data and implementation of an employer survey (Appendix A) to understand more clearly the existing educational context and the gap between graduate skills and employer expectations. The baseline study included a course feedback survey, focus group interviews and an exercise given to test students' ability to apply their knowledge to a case study (Appendix B). A review of the literature provided background information about the educational culture of the country and the tertiary sector.
2005	Design and implementation of the intervention based on established theory and an understanding of the existing culture and workforce challenges revealed by the literature review.
2006	Revision of the intervention based on the results of focus groups and the course feedback survey conducted in 2005 (Appendix B).
2007	Revision of the intervention based on the results of focus groups and the course feedback survey conducted in 2006 (Appendix B).

At the time that the study was commenced, the Dean of FIT (my Associate Supervisor) and I had agreed that the faculty should look at adopting the PBL approach in additional courses after the initial pilot. Although the level of input required for the revision of interventions precluded this, I did request, and was granted permission, to take on the co-supervision of industry projects for the 2006 student batch[9] in my capacity as Visiting Lecturer. The objective here was to try to assess whether any of the gains made in the Software Engineering course were being carried over to the project. This would have been consistent with the different aims of the PBL-based Software Engineering course and the project subject. As Perrenet et al. (2000, p.348) point out, 'Project work is more directed to the application of knowledge, whereas PBL is more directed to the acquisition of knowledge'. The second year Industry Project (IT2999: ICT Design Project) that these students were enrolled in requires students to make contact with local businesses and negotiate to design new software systems for them. As the first stage of this project was the development of a Software Requirement Specification (SRS) similar to that prepared for the final assignment of the Software Engineering subject, it presented itself as an ideal avenue for checking whether skills acquired in Software Engineering were successfully being applied by students beyond that context.

2.2.1 The Role of the Researcher

Throughout the four years over which the research was conducted, I worked in partnership with the course lecturer and a number of other faculty staff. In the first year of piloting the intervention, I was able to draw on the expertise of two lecturers who had experienced undergraduate study overseas where small group and collaborative learning were the norm. All three lecturers participated in my

[9] "Batch" is the term used in Sri Lanka to describe a group of students who enrol in an institution at the same time. Referring to the 2004 batch is equivalent to referring to the 2004 intake or cohort.

introductory seminars on the topic of PBL made to the faculty in 2004/5 following a study tour of institutions using the PBL approach by myself and the Dean in 2004. Additionally, in 2005, the course lecturer and one of the other facilitators attended a PBL Conference at Temasek Polytechnic in Singapore.[10] With the departure of the two supporting lecturers in 2006 in pursuit of higher studies in the UK, the course lecturer obtained the services of three university instructors[11] to help provide support to student groups in tutorials. Unfortunately, these people did not have a background in small group work and so could not be expected to facilitate groups by themselves without extensive training for which they could not be released. At this point I discussed with the Dean and the principal lecturer the possibility of taking a more direct role in conducting the Software Engineering course to compensate for the loss of capacity caused by the departure of the original facilitators. We agreed that I should co-teach the course as a Visiting Lecturer. For the most part, the principal lecturer conducted the lectures whilst I and the instructors took on responsibility for tutorial sessions. The instructors acted as "floating facilitators" working with teams as questions or problems arose. I directed the group as a whole to alternating small group discussion, class discussion, mini-lectures and report back sessions. In this, we followed the model of implementing PBL in large class settings recommended by Duch (2001).

Since the primary goal of the intervention was to pilot the adoption of PBL in FIT, I felt that it was important that lecturers and tutors/instructors worked closely with me, not only in implementing the intervention, but also in planning the design and analyzing the results. Robinson (in DBRC 2003, p.7) states,

> [I]n design-based research, practitioners and researchers work together to produce meaningful change in contexts of practice (e.g. classrooms, after-school programs, teacher on-line communities). Such collaboration means that goals and design constraints are drawn from the local context as well as the researcher's agenda, addressing one concern of many reform efforts.

It was also important that we all had a shared understanding of, and commitment to, what the course design was meant to achieve to avoid "lethal mutations" - a term used by Brown and Campione (in Collins et al. 2004, p.17) to describe the situation where the goals and principles underlying the design are undermined by the way the design is enacted. As well as sharing the teaching load, the research team met weekly both to discuss observations of student reactions to the course and to plan for the following week. Once a semester, I recorded formal interviews with my co-researchers. I anticipated that the familiarity of my co-researchers with the local context would be a valuable guide at all stages of the research.

> Participants in DBR are acknowledged as co-participants in the design and analysis. In traditional experimental studies, participants are usually known as "subjects" who are assigned randomly to treatments. In DBR, co-participants' expertise and in-depth understandings are essential to the research process and outcomes (Yutdhana 2005, p.171).

Although the traditional role of the researcher is that of observation at a distance removed from the classroom, I elected to interact directly with students in tutorial classes and the occasional lecture. I felt that my interaction with the students and lecturers and my direct experience of the university learning environment allowed me to better understand the feedback received through focus groups and

[10] "Adaptive Strategies for PBL in a Supercomplex World", 15-16 March, 2005

[11] Public universities in Sri Lanka commonly employ instructors to assist lecturers in marking, conducting tutorials and other administrative matters. Instructors are usually locally trained graduates.

questionnaires. My direct involvement with the students also gave me the opportunity to stress to them the importance of their own roles in helping to improve the course learning environment by providing meaningful feedback on what they had experienced in focus group sessions and through the participant course experience questionnaire.

Hoadley (2004, p.205), taking on the dual roles of teacher and researcher argues,

> In design-based research, the process of forcing the same people to engage the theory, the implementation of intervention, and the measurement of outcomes encourages a greater degree of methodological alignment. … forcing individuals to carry ideas all the way from explanation to prediction to falsification to application seems like the missing link in educational research that will ensure our theories have practical implications. Indeed, we may have been deceiving ourselves all along, in that we never really had a handle on whether our treatments really represented the theory-interpreted conditions they were standing in for. In situations where the relevant variables of learning are multitudinous (thousands of contextual, individual, and group factors; myriad teacher decisions made on the fly) and hard to control out, being intimate with the research setting and linking on an extremely fine scale, the designed and enacted intervention may be our best hope for relevance.

In program evaluation methodologies oriented more to ethnographic procedures than to measurement procedures, the researcher is required to maintain a physical presence in the research setting. One such approach, the illuminative evaluation model, was originally developed as an educational evaluation approach that emphasized context and interpretation (Patton 2002). In its emphasis on documenting how a program has changed and been shaped by its context, in its focus on stakeholders' personal perceptions and experiences, and in its progressive focusing on emergent issues which are identified and explored gradually over time (Maxwell 1984), the illuminative evaluation model closely parallels the approach used in this study.

> The aims of illuminative evaluation are to study the innovative program: how it operates, how it is influenced by the various school situations in which it is applied; what those directly concerned regard as its advantages and disadvantages; and how students' intellectual tasks and academic experiences are most affected. It aims to discover and document what it is like to be participating in the scheme, whether as teacher or pupil, and, in addition, to discern and discuss the innovation's most significant features, recurring, concomitant, and critical processes (Parlett & Hamilton in Patton 2002, p.172).

Whilst I would argue that the aims and approaches of the illuminative evaluation model and similar ethnographic methodologies are consistent with my own, mandating my presence in the research setting, it must be acknowledged that direct interaction with research subjects always brings with it a risk of bias (Lagemann 2002; Barab & Squire 2004).

> [S]cholars of education have … now begun working to develop new approaches to education research. These have often involved design experiments in which a researcher develops an innovation and then investigates it while implementing it. According to traditional disciplinary canons of rigor, this mode of research can be seen as subjective and open to bias. And yet, such research is likely to be extremely productive in education, where research must be usable to be effective. The challenge now is to find new ways to address matters of bias so the results of such work can be trusted (Lagemann 2002).

2.2.2 Addressing the Issue of Bias

The Design-Based Research Collective (2003) suggest that impartiality of findings can only be ensured by substantiating one’s observations through triangulation from multiple additional data sources.

> Reliability of findings and measures can be promoted through triangulation from multiple data sources, repetition of analyses across cycles of enactment, and use (or creation) of standardized measures or instruments (DBRC 2003, p.8).

With this in mind, I drew on the following range of data sources in presenting the results of the research:

1. Personal Observations of the researcher and lecturers. These draw on notes made after weekly meetings with the research team (the course lecturer and/or instructors).
2. Focus Group Interviews – 3 groups were interviewed after each semester of the intervention. This represented the views of 24 students (equivalent to 51% of the baseline batch of 2004, 49% of the 2005 batch, 23% of the 2006 batch, and 23.5% of the 2007 batch).[12]
3. Student Surveys – all students were asked to fill in a Course Experience Questionnaire after each semester of the intervention. The return rates were as follows : 94% of the baseline year group, 67% of the 2005 group, 78% of the 2006 group, and 76% of the 2007 group).
4. Student reflections – students were asked to reflect on aspects of the course and submit written reflection papers. The 2005 batch was asked to submit two reflection papers – one on learning and one on teamwork and the 2006 batch to submit a single reflection on teamwork. Submission of reflection papers was part of required coursework.
5. An in-class exercise was given to students in their Software Engineering class in the baseline study to test application of knowledge skills. This exercise required them to put themselves in the role of a consultant interviewing a client in order to prepare a cost estimate for a project. To complete the exercise they had to use their theory knowledge of software cost estimating and apply it to the context of the imaginary client's corporate profile. A copy of the exercise is included in Appendix B.
6. Assessment marks (formative and summative assessment results were used as separate indicators given that the former was based on assignment work and the latter on examination results).
7. Convergent interviews with faculty lecturers at the beginning of the study followed by informal discussions thereafter. Convergent interviewing is a form of diagnostic interview which can be used to probe for opinion on an issue where interviewees may have widely divergent viewpoints. Interviews are unstructured; apart from an initiating question, interview questions are not pre-set which decreases the likelihood of responses being constrained by the questions asked. Instead respondents are led to talk about the issue of interest for something between 45 minutes and one hour by the use of prompts which either ask the interviewee to explain divergent opinions expressed by his/her colleagues or which challenge him/her to find exceptions in areas where there has been broad agreement (Dick 2002a; Dick 2002b). In this case the initial

[12] The focus groups were conducted each year by a local market research company, ACNielsen Lanka (Pvt) Ltd in the Sinhala, English and Tamil medium. The discussion guide for the groups was prepared by the candidate with input from the research team and the focus group moderators were briefed by the candidate prior to conducting the groups.

question posed to seed the interview was, "What sort of graduates should FIT try to produce and what is being done or can be done to achieve this?"

8. Formal interviews with the research team at the end of each iteration of the course (2005, 2006 and 2007).

Care was taken throughout the study to ensure that students knew that their feedback was given anonymously. Focus groups were conducted by a third party external to the university who stressed to respondents that anything said in the focus group would be treated confidentially. Accordingly, they provided session transcripts with the names of respondents substituted by a code.

Focus group discussion guides for each year, copies of the Course Experience Questionnaire for each year, copies of questions inviting student reflections, and a copy of the in-class exercise given to students as part of the baseline study are included in Appendix B.

Hoadley (2004, p.205) cautions that,

> [B]ecause the researchers [in DBR] are participant-observers who intervene deliberately in the settings they study, it is incumbent on the researcher to describe and monitor ways that their own agenda is responsible for the results. A researcher may produce a successful outcome due to a wonderful theory or an effective treatment or through unintended aspects of her or his own participation in the situation. Design-based researchers must not only document their perspective or starting point, but must also document any plausibly relevant interventional strategies used not only by participants observed, but also by the researcher herself or himself.

This caution is well-founded and is echoed by Denscombe (2003, p.273) who advises,

> [T]he role of the self in qualitative research is important, and there is a growing acceptance among those involved in qualitative data analysis that some *biographical details about the researcher warrant inclusion as part of the analysis*, thus allowing the writer to explore the ways in which he or she feels personal experiences and values might influence matters.

As an outsider in Sri Lanka my views and actions, even my very presence, were likely to influence the students particularly when they came to know me better through my involvement in both the IT2999 and IT2104 courses in 2006 and IT2104 in 2007. My philosophical orientation to education is constructivist with a personal preference for self-learning in the context of well-crafted learning experiences. It may well have been apparent to students that I was sceptical of the value of lectures – particularly those presented in Software Engineering which were content-heavy, highly conceptual and used a level of English that did not make concessions for learners of the language. I was also convinced that PBL in particular and collaborative learning in general should be foundations of the learning environment at FIT.

Other possible sources of influence include;

- That I was an English-speaking foreigner. In direct terms, this meant that some students had difficulty in understanding my accent - a negative factor impacting on those occasions where I was called upon to give lectures but unlikely to have a serious impact in the group work atmosphere of the tutorial sessions. There is also evidence (refer to Chapter 6) that some students welcomed the opportunity to practice communicating with a foreigner as most of them expected to gain employment in firms with foreign clients. In indirect terms, some students may have resented participating in research /

coursework conducted by a foreigner (refer to Chapter 3 for a discussion of the Jathika Chintanaya movement).;

- That I, the course lecturer, and all of the instructors (with the exception of one of the facilitators in the first year), were female;[13]
- Activities that I introduced to build team spirit such as team games and competitions with team prizes;
- That I was observed to meet frequently with the Dean and senior staff of FIT and was prepared to take student concerns as expressed in focus groups / questionnaires to senior staff meetings;
- That I was involved in setting and marking assignments while the course lecturer (a member of FIT academic staff) was involved in setting and marking examinations.

Brown (1992) cautions about a possible "Hawthorne Effect" referring to the fact that '[a]ny intervention tends to have positive effects merely because of the attention of the experimental team to the subject's welfare' (Brown 1992, p.163). There may well have been a Hawthorne Effect on the study. A student in the 2007 focus group made the comment that only I did research to understand students and their progress; other lecturers did not.

While students certainly knew me better as the result of my direct involvement in the course after 2006, I feel that I would have had an influence on the outcome of the study whether I had been directly involved in conducting the course or not. Even in the first year of the study, when I was not directly involved with students and conducted most of my meetings with lecturers off-campus, students were aware of who I was and took a keen interest in what I was doing. The question of whether the study did achieve the results it did because of a Hawthorne Effect or whether better results might have been achieved with a different lecturer and/or researcher cannot be answered in a small-scale study of this nature. The limitations that the scope of the research imposes on the ability to generalise the findings beyond the immediate scope of the course and the Faculty is recognised and Chapter 8 presents a plan for a future study with a wider scope.

2.2.3 Data Analysis

Denscombe (2003, p.277) makes the important point that, unlike in quantitative analysis,

> The process that leads from the data to the researcher's conclusions gets ignored, with the reader of the research report being given little or no indication of how the data - for example, tape-recorded interviews - were actually analysed. This missing element is being noted increasingly as a weakness of qualitative research. Quite rightly, those who use qualitative data are now expected to include in their accounts of research a description of the process they used to move from the raw data to their findings.

Accordingly, in this section, I propose to give a general account of how the data (the focus group transcripts, interview transcripts, notes taken from anecdotal discussions with staff members, course participation questionnaires, student reflections and

[13] In the first year, of the eight academic staff, six were male but, in the final year of the study, of the eleven academic staff, six were female. In 2004, there was only one male instructor; in 2007, there were four instructors – all female.

assignments described above) were analysed. More detailed accounts are given in Chapters 5-7 as the analysis of findings from each year of the study are discussed.

In reviewing focus group and questionnaire responses and student reflections, I used inductive data analysis strategies to allow themes and categories to emerge from the data. As such, I did not start the coding process with a list of predetermined codes but instead used a process of open coding whereby the ideas presented in the data were categorized as they were encountered. In this way I hoped to provide myself with ample opportunity to discover unexpected ideas in the data. The idea of allowing the theory to emerge entirely from the data without being masked by preconceptions derived from existing theory is one of the central tenants of Grounded Theory (Glaser 1965; Dick 2002a; Dick 2002b; Denscombe 2003). While this study does not take a pure Grounded Theory approach, I felt that an approach to coding which allowed concepts to emerge from the data was appropriate to the open-ended nature of my research questions. As PBL approaches are relatively new to Sri Lanka, I felt that the interplay of context and pedagogy needed to be observed and questioned and hoped that the flexibility inherent in this approach would allow unexpected as well as anticipated results to emerge.

As related codes emerged, I endeavoured to classify them, as appropriate, as the properties (sub-categories) of categories or dimensions of existing categories (Dick 2002b). Denscombe (2003, p.120) states,

> As the codes take shape, the researcher will look for relationships between the codes - links and associations that allow certain codes to be subsumed under broader headings and certain codes to be seen as more crucial than others. This is referred to as *axial coding*, since it shifts the analysis towards the identification of key (axial) components. Eventually, the researcher should be in a position to focus attention on just the key components, the most significant categories, and concentrate his or her efforts on these. This *selective coding* focuses attention on just the core codes, the ones that have emerged from open and axial coding as being vital to any explanation of the complex social phenomenon.

In most cases, I was able to identify a single core category to which other themes or categories were linked. The concept of a core category is again borrowed from grounded theory. 'A core category is a main theme; it sums up a pattern of behaviour pulling together identified concepts which have a relationship to each other' (Goulding 2002, p.123).

The categories, their dimensions and properties, emerging from the data are summarized in the form of concept maps in Chapters 5-7. As the connections between categories / properties became apparent, I wrote memos describing the connection. Where appropriate, I drew upon existing theory to understand the nature of the emerging relationships between categories. On this basis, tentative theories were postulated. Theories and core codes emerging through research conducted in 2005 provided a direction for research in 2006; likewise core codes and tentative theories / memos emerging through research conducted in 2006 provided a direction for research in 2007. This is consistent with advice from Denscombe (2003, p.272) who states,

> As various explanations and themes emerge from the early consideration of the data, the researcher should go back to the field with these explanations and themes to check their validity against 'reality'.

Commencing a program of research with an open-ended exploratory study of this nature is consistent with the model of DBR presented by Gorard (2004) which suggests that a DBR program should work through three phases - a feasibility study, prototyping and trialing and, finally, a field study with only the final field test stage taking the form of a definitive test such as a randomized controlled trial, an interrupted time series analysis or a concurrent quasi-experiment. Consistent with this approach, recommendations are made in the final chapter of this thesis for the design of a field test based on the theoretical propositions which emerge from the analysis reported in this study.

All students attending lectures at the end of the semester were asked to complete a course experience questionnaire. This was based on the University of Sydney 2003 Course Experience Questionnaire[14] and the LTSN (Learning & Teaching Support Network) Nationwide Survey[15] of Student's Experience in Studying Economics, and adapted to suit the learning environment and the English language skills of the Moratuwa students.

Although questions asked in the Course Experience Questionnaire each year varied slightly to match the changing focus of the research agenda, critical questions were repeated each year so that findings could be compared to the feedback obtained from the baseline survey. A chi-square test was done on the scores for each question, comparing each year to the baseline results.

While valuable software tools exist to support the analysis of qualitative data, including Ethnograph,[16] Nud.ist NVivo[17] and ATLAS.ti,[18] I did not make use of such tools in the current study as the small scale of the study did not require this level of support and I was also concerned that the mechanical process of coding and linking would distance me from the context of the data. Instead I preferred to take the more time consuming path of commenting raw transcripts using the commenting tool in Microsoft Word while maintaining memos and the emerging open coding scheme in separate files. Where hardcopy only was available, separate notes were taken.

2.3 Towards an initial Design

The initial design was based on information about the context of the study drawn from three sources. These included a survey undertaken with potential employers of FIT graduates, a baseline study undertaken with students following the Software Engineering course in 2004 prior to the intervention, and a desk study of the historical background to education in Sri Lanka. This information, presented in the next chapter, constitutes the first steps towards a rich description of the context of the study. Based on the understanding of the context derived from these studies and an exploration of relevant learning theory, an initial design was derived which took the form of a work plan, student exercises and assignments, and a supporting set of eLearning tools. This initial design is described in Chapter 4 couched in terms of the relevant theory.

[14] http://www.itl.usyd.edu.au/CEQ/
[15] http://www.economicsnetwork.ac.uk/projects/stud_survey2002.htm
[16] http://www.qualisresearch.com
[17] http://www.qsr.com.au
[18] http://www.atlasti.com

CHAPTER 3

The Gap between Employer Expectations and Educational Inputs

As discussed in the previous chapter, DBR differs from standard experimental research which seeks to come up with generalizable findings by controlling variables. In DBR, the goal is more one of thoroughly documenting the context and the design of the intervention, and situating the latter in relation to established theory such that a practitioner elsewhere can assess whether his/her own circumstances are sufficiently similar to be able to reasonably expect portability of the described solution.

> One of the central ideas in the scientific paradigm is replicability; however, because design-based researchers cannot (and may not want to) manipulate cultural contexts, it becomes difficult to replicate others' findings (Hoadley, 2002). Therefore, the goal of design-based research is to lay open and problematize the completed design and resultant implementation in a way that provides insight into the local dynamics. This involves not simply sharing the designed artifact, but providing rich descriptions of context, guiding and emerging theory, design features of the intervention, and the impact of these features on participation and learning (Barab & Squire 2004, p.8).

This chapter seeks to initiate the documentation of the context of the study by describing three sources of information on which the initial design was predicated. These include a study of employer perceptions of desirable soft skills for new graduates in the field of Information and Communications Technology (ICT); a literature review of the historical background to education in Sri Lanka with a focus on issues of relevance to the context of the study and a baseline study of student perceptions of their education relevant to employer expectations.

3.1 National Sector Surveys

The 2005 National IT Workforce Survey (SLICTA 2005) and the earlier SEARCC-sponsored Regional ICT Manpower Survey in 2000/2001 (CSSL 2000/2001) both pointed to shortfalls in the soft skills of graduates entering the IT industry in Sri Lanka. The 2000/2001 survey concluded that, ‘Graduates demonstrate a high level of domain/technical knowledge absorption, but do not fare significantly better in many other skills. With respect to interpersonal skills and work attitude, their absorption is lower than that of non-degree holders. In contrast, foreign graduates outperform non-graduates in the absorption of all skills listed, as perceived by the respondents’ (CSSL 2000/2001, p.10). The 2005 survey (SLICTA 2005) indicated that the situation had not improved to any significant extent and this was corroborated by anecdotal feedback given to FIT faculty members by industry representatives.

Employers are widely critical of the attitudes and personal attributes of university graduates from the public university sector generally and, partly as a result of this, graduate unemployment levels are high island-wide.[19]

[19] ‘The unemployment rate (in Sri Lanka) is highest among educated youth. The rate has decreased from around 30% in 1990 to 17% in 2002 for those who have GCE (A/L) or above. However, the unemployment rate is still higher for educated youth, than the less educated groups. The situation is worse for females compared to males’ (Nanayakkara, AGW 2004, *Employment and Unemployment in*

3.2 Employer Perception Survey

In an attempt to define more precisely what it is that employers in the ICT industry are looking for, I worked together with the Dean of FIT, Dr. A. P. Madurapperuma, to replicate an Australian industry survey on desirable graduate attributes undertaken by Dr Robert Snoke and Associate Professor Alan Underwood of QIT[20] in 1998/1999 (Snoke & Underwood 2001). It was anticipated that the results of this study would paint a detailed picture of the sort of graduate that industry employers were looking for and put a face to what had previously only been anecdotally expressed as a general dissatisfaction with graduate soft skills. It would then be up to the faculty to find a way to help its students acquire the desired skills and attributes.

As in the Australian version of the study, employers were asked to rank 28 graduate attributes on a scale of 1 (extremely unimportant) to 7 (extremely important / essential). General consensus on ranking was sought through an iterative Delphi approach.[21] There was an opportunity for Sri Lankan employers to volunteer additional attributes and ultimately 40 attributes were ranked. The Sri Lankan employers contacted were those who participated in an earlier ICT sector survey many of whom represented the software development industry and had close associations with the university.

The findings of the Sri Lankan study (included in Appendix A) follow a similar pattern to those of the Australian study (Table 3.1). The ability to *Work as part of a team in a productive and cooperative manner,* ranked in second place by Australian employers, was also rated highly by Sri Lankan employers. This reflects the nature of the work environment in the ICT industry worldwide where there is a heavy emphasis on teamwork (ICEL 2006; ILO et al. 2006). Similarly, the high value placed on a *willingness to accept a lifelong commitment to professional development* reflects an internationally recognized characteristic of the industry - rapid change and the need for employees to be committed to ongoing professional development to keep abreast of change.

Table 3.1: Comparative ranking of graduate attributes in Sri Lankan and Australian Studies

Graduate Attributes[22]	Ranking Australian Study	Ranking Sri Lankan Study
Accuracy and attention to detail[SL].	-	**1**
Posses a 'can do' attitude[SL].	-	**2**
Self-motivation.	6	**3**
Be highly committed to one's work[SL].	-	**4**
Willingness to accept constructive criticism[SL].	-	**5**

Sri Lanka - Trends, Issues and Options, Sri Lanka Department of Census and Statistics, Colombo, Sri Lanka, p.26).

[20] Queensland Institute of Technology, Australia now Queensland University of Technology

[21] The Delphi technique uses a series of questionnaires to aggregate the knowledge, judgments, or opinions of experts in order to address complex questions. Individual contributions are shared with the whole group by using the results from each questionnaire to construct the next questionnaire (Roth, RM & Wood, WC 1990, 'A Delphi Approach to Acquiring Knowledge from Single and Multiple Experts', *1990 ACM SIGBDP conference on Trends and directions in expert systems*, ACM, Orlando, Florida, p.301-324).

[22] Those attributes identified with the superscript 'SL', were suggested by employers in the Sri Lankan study and were not part of the original Australian study.

Graduate Attributes[22]	Ranking Australian Study	Ranking Sri Lankan Study
Work as part of a team in a productive and cooperative manner	2	**6**
Considers the quality of the solution and its timeliness.	10	**7**
Being well organised and well disciplined[SL].	-	**8**
Willingness to embrace change and to engage in incremental improvement to keep up with the rapid change in technology	13	**9**
Willingness to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.	1	**10**
Willingness to take direction from more experienced colleagues even though that person may not have a university qualification[SL].	-	**11**
Confidence about their ability to learn independently	15	**12**
Ability to think and act rationally[SL].	-	**13**
Ability to comprehend oral and written instructions[SL].	-	**14**
Interpersonal skills	8	**15**

However there are interesting differences in the findings of the two studies. Firstly, Sri Lankan employers seem to be far more concerned about attitudes and personality traits than their Australian counterparts participating in the original study. This preoccupation of Sri Lankan employers is often reflected in anecdotal reports of employer concern about "poor attitudes" amongst university graduates.

Secondly, Sri Lankan employers are more concerned about subject matter knowledge than Australian employers. They also appeared to be less concerned about communication skills - other than the ability to understand instructions.[23] However, there may well be common ground behind these findings with comments from some Sri Lankan employers suggesting that they responded in this way because they are looking to employ new gradates to fill entry-level positions in their programming units with people who do not require further training and who can accept direction. Similarly, Turner & Lowry (1999, p.1056) working in Australia concluded, '[E]mployers want new graduates who will be immediately productive at relatively low level work …..(They) seem to want graduates who can accept their position within an organization and accept direction'. Hence it is important to look closely at what employers mean when they put a high value on oral and written communication skills – does it, in fact, merely reflect a wish to have employees who can understand instructions. Of greater concern were comments purportedly made by Sri Lankan employers to FIT staff (De Mel, G. 2005, pers. comm., April 28) to the effect that they do not expect public university graduates to have good English and communication skills and hence employ them initially into positions where they will not come into direct contact with clients.

This desire to recruit new graduates to entry level positions may also explain the relatively low importance given to problem-solving skills in comparison with the

[23] The attribute, *Ability to comprehend oral and written instructions* was not part of the original Australian survey but was volunteered by Sri Lankan employers and ranked 14th (out of 40). This can be compared to the ranking of attributes, *Oral communication skills* (ranked 24th by Sri Lankan employers and 4th by Australian employers) and *Written communication skills* (ranked 30th by Sri Lankan employers and 9th by Australian employers).

results of the Australian survey. The attribute *Considers the quality of the solution and its timeliness* was ranked quite highly (Table 3.1) but this may reflect employer concerns about time-management skills[24] more than anything else. General problem solving skills were regarded as being far less important with *Ability to analyse, synthesise and evaluate the various solutions* and *Defines problems in a systematic way* and *Ability to retrieve, evaluate and use relevant information* being ranked towards the middle of the listing. In the Australian study (Snoke & Underwood 2001) these attributes were ranked towards the top of the list.[25]

3.3 Limitations of the Learning Environment

Given the employer expectations and frustrations communicated from the survey (Madurapperuma & Macan Markar 2006), it was apparent that there was something of a mismatch between the expectations of the IT industry and the skills set of IT graduates. This mismatch typifies a widely recognized conundrum between employer expectations of university graduates and the actual skills sets of graduates from the Sri Lankan university system generally (Matthews 1995; de Mel 2007; Chandrasiri 2008; Hettige 2008). The gap has been the subject of comment since at least 1971 (Seers in Chandrasiri 2008) and hence has a long history. This history is the topic of the following section.

3.3.1 Sri Lankan post-Independence education system

In Sri Lanka, education has traditionally been an important avenue of social mobility providing young people from poorer families and/or from rural areas with access to desirable jobs (Little 1997). This has been the case since the passing of the “Free Education Act” in 1945 just prior to independence in 1948 which provided all students with access to free education up to the level of the first degree. During the 50’s, 60’s and into the 70’s, with the economy dominated by state enterprises, the socialist governments of the time were able to maintain a relatively egalitarian system of access to employment, although this was somewhat tainted by systems of political patronage. Up until the present, the government continues this agenda, providing support for transport, books, school uniforms and scholarships for the needy as well as fee-free education. While market forces and political patronage increasingly act to limit the social mobility value of education (Hettige 2000; Samaraweera 2007), statistics show that education attainment is still positively correlated with occupation class (World Bank 2004).

However, increasing access to education has brought with it a problem of educated youth unemployment with unemployment rates of young GCE O/L and GCE A/L and university graduates ranging from 26-34% for both sexes combined (World Bank 2004). Some analysts maintain that the primary reason for this is structural unemployment caused by the slow pace of economic growth, which has prevented the creation of adequate jobs to match the supply of educated youth (Gunawardena 1991; World Bank 2004). Others maintain that the problem is due to a skills mismatch with opportunities at higher levels of the public sector and in the private sector limited for many university graduates who do not ‘possess the attributes that private sector employers [look] for. These include communication skills, computer

[24] When given the opportunity to make additional comments, several employers mentioned time management issues.

[25] *Ability to analyse, synthesise and evaluate the various solutions* – ranked 7 of 28; *Defines problems in a systematic way* – ranked 5 of 28; *Ability to retrieve, evaluate and use relevant information* – ranked 3 of 28.

literacy, and other aspects of cultural capital valued in corporate circles' (Hettige 2008).

> [T]he majority of the graduates who come out of the universities are in the age group 25-29 years. This is one of the main reasons for their inability to gain suitable employment, specially in the private sector. Another reason seems to be their knowledge of English. Private sector organizations prefer younger persons with perhaps G.C.E. (A/L) and with a reasonably good knowledge of English. When such persons enter the private sector at a relatively young age, get experience and on the job training for about 6 to 7 years, they are better equipped to run the activities of the private sector organizations than the graduates without a sufficient knowledge of English, who come out of the Universities at the age of around 27 years and with no work experience (Nanayakkara 2004, p.21).

Yet another perspective on the issue highlights the phenomenon of job queuing. The dream of most Sri Lankan students graduating with G.C.E A/L qualifications is to gain employment in white-collar positions in large private sector organisations or in government (Hettige et al. 2004; Samaraweera 2007). These sectors are considered together as the 'protected' sector.[26] A limited number[27] of students with A/L qualifications will be fortunate enough to gain entrance to tertiary training institutions but in general this will only delay their search for employment in the same 'protected' sector.

> Only around 24 to 30 percent of those who sit for GCE (O/L) have been qualified for GCE (A/L) during the last few years. Out of around 200,000 candidate who sit for the GCE(A/L) nearly 50 percent gets qualified to enter the Universities. However, only around 16 percent of those who get qualified are admitted to the Universities. That is also after wasting either one or two years of their valuable and useful time, in most of the cases just doing nothing. Only a few children, specially those in the urban areas and whose parents could afford, make use of this period to get themselves trained in IT, accountancy, management, etc. Such children are well equipped by the time they enter the universities. But what percentage of parents can afford to do this. Out of around 350,000 children who enter the school education system each year, only around 12,000 or 3.4 percent are entering the Universities, which means that only the best can gain entry to the Universities (Nanayakkara 2004, p.21).

Supported indefinitely by their parents, Sri Lankan graduates and those who have passed through the school system are prepared to wait for years for private corporate or government jobs despite the availability of jobs outside the 'protected sector' (Rama 1999; Nanayakkara 2004; Nissanka 2005). The average wait time between graduation from school or university and work is one year (Hettige et al. 2004; World Bank 2004) but World Bank studies have found that less than 20% find employment in the first 4 years after graduation (Samaraweera 2007).

---

[26] Government jobs are significantly more lucrative than comparative private sector opportunities particularly for the less educated. There are also substantial earnings gaps in favour of employees of the larger private sector institutions which are covered by the country's job security regulation (Termination of Employment of Workmen Act – TEWA) and protective tariffs. The TEWA states that a worker who has spent one year or more with the same employer and has not committed a disciplinary fault cannot be legally dismissed, except with the consent of the Commissioner of Labour. The process leading to this consent may take years, during which the firm has to keep paying the salaries of the redundant worker. If and when the authorization is granted, the required compensation may amount to several years of salary. (Rama, M 1999, 'The Sri Lankan Unemployment Problem Revisited', *Policy Research Working Paper Series*, World Bank Development Research Group).

[27] 'Less than 3% of the university age group in Sri Lanka is enrolled in public universities – compared with 8% for South Asia as a whole – even though 25% meet university requirements' (ADB 2003, *Expanding Sri Lanka's Postsecondary Education with Distance Learning*, media release, Asian Development Bank, Manila, Philippines, viewed June 13, 2003 at http://www.adb.org/printer-friendly.asp?fn=%2FDocuments%2FNews%2F2003%2Fnr2003084.asp).

The situation has been exacerbated by a program of liberal economic reforms embarked on since the late 70's, which has brought about a sharp decline in the number of government sector jobs[28] (Hettige 2000; ADB 2000a) while at the same time lower status positions in state institutions are often allocated on the basis of political patronage barring entry to those without the right connections (Hettige 2000).

Whatever the reason or reasons behind the large numbers of unemployed graduates, the situation has resulted in intense competition for qualifications to secure the limited number of desirable positions available and in the government having to step in regularly over the past three decades to absorb unemployed educated young people, especially university graduates, into public employment to forestall political discontent and social unrest. Educated unemployed young people played a leading role in violent civil disturbances in 1971 and 1987-89 (spearheaded by the Janatha Vimukthi Peramuna – JVP or People's Liberation Front) and in the separatist movement in the northern parts of the country from the 1970's onwards (Liyanaarachchi 2003) and there is a fear that such violence could erupt again.

3.3.1.1 The Sri Lankan "Diploma Disease"

In an environment where desirable jobs are scarce and where education (itself in short supply) is seen as the key to good employment, competition between individuals becomes extremely high. In Sri Lanka this competition for educational qualifications has resulted in what Dore (1976) called the Sri Lankan "Diploma Disease"– whereby qualification escalation and increased competitiveness leads to 'a "distortion" of the classroom curriculum towards the examination requirements of the minority and away from general educational requirements that benefit the majority' (Little 2000, p.305).

> It is not surprising that examinations dominate the curriculum, that all learning is ritualised, that curiosity is devalued, that no one is allowed to stray from the syllabus, that no one inquires about the usefulness, the relevance, or the interestingness of what is learned (Dore 1976, p.61).

In Sri Lanka, the "Diploma Disease" has resulted in all students feeling compelled to compete in a series of content-based examinations. Sri Lankan children face their first examination hurdle as early as the fifth year of primary school. While the Year 5 scholarship examinations play an essential role in promoting equity of opportunity - successful pupils from disadvantaged schools are entitled to transfer, with state assistance, to better schools for their secondary education – they also contribute to the intensely competitive nature of the education system since students who gain entry to the better schools have a consequent advantage when facing the GCE O/L and A/L examinations. Even so, many students repeat their A/L examinations multiple times to improve their chances of gaining entry to university.

A comprehensive study by the National Institute of Education in 1993 (Little 1997) of the impact of the Year 5 scholarship examination revealed that education in Sri

[28] The socialist government of the 50s and 60s established a state-centred economy under which employment in the public sector was seen as attractive both in terms of security and status. Many university educated rural youth gained employment in the public sector. Moves by subsequent governments to cut back on public sector spending and encourage growth through the expansion of the private sector (many state enterprises were privatized after 1977) have resulted in far fewer government jobs.

Lankan primary schools has become purely teacher centred. Kotalawala in Little (1997, para. 54) states,

> Children are simply coached to answer scholarship examination question papers …students were grouped in preparation for the Year 5 scholarship examination from as early as Year 3…Parental "interference" contributes to the situation; this interference is caused by the competition to gain entrance to 'popular' schools...

Most resources in the system are focused on the small percentage of each age cohort who can be expected to go on to tertiary study. This is only slowly beginning to change. Even today, most Sri Lankan students spend a lot of their "free" time in tutory classes where they rote learn answers for anticipated examination questions which will provide them with a ticket to tertiary study.

> Private tuition is a common phenomenon in Sri Lanka and is used by students to increase the chances of examination success. Private tuition is followed in organised classes in school buildings and other premises or in one-to-one tutoring in homes. Estimates suggest that 75% of Year 11 students were taking private tuition for the GCE O level exam in 1989. This rose to 92% among GCE science A level students….Students in the 1989 sample spent an average of 9.1 hours per week attending private tuition classes. Not surprisingly, large proportions of children reported that they had little time available for activities other than attending school and private tuition and attending to homework arising from both (Little 1997, para. 37).

This situation is particularly acute for less privileged students. Under the socialist government of the 50's and 60's, restrictive currency exchange controls limited the amount of money that could be taken out of the country and the volume of foreign goods which could be purchased. However, since the relaxation of these exchange controls in the 80's, middle and upper class families have been able to send their children overseas and many do so, or alternatively, enrol their children in local, private sector, post secondary institutions which commonly offer degree qualifications through affiliations with foreign universities. The overall tertiary education enrolment rate in Sri Lanka (including both government and private sector institutions) is about 11% of the eligible population. This is slightly above the South Asia average (10%), and approximately equal to countries such as India, Morocco, Vietnam and Mauritius. However, the major proportion of tertiary enrolment, about 6%, is in courses outside the public university and formal technical education sector (World Bank 2004). Fees for these private sector courses are a barrier to underprivileged youth, leaving children from less privileged backgrounds to compete for limited places within the local public university sector. In an online media release in 2003, the Asian Development Bank stated that, 'Less than 3% of the university age group in Sri Lanka is enrolled in public universities – compared with 8% for South Asia as a whole – even though 25% meet university requirements' (ADB 2003). These figures give an idea of the level of competition for places.

Although it might not directly help underprivileged school leavers, further privatization of the tertiary sector is the only economically viable solution for Sri Lanka with 'an average tertiary education expenditure per student as a share of national income per capita [which], at 100%, is slightly higher than India, and substantially above the level in East Asian countries such as South Korea, Singapore, Malaysia, Thailand, Indonesia and the Philippines' (World Bank 2004, p.38). Attempts to reduce this excessively high level of expenditure through other means such as levelling fees or building the capacity of the public universities to earn income through consultancies have only resulted in student unrest (Fernando 2004). This being the case, it is likely that Sri Lanka's "Diploma Disease" will afflict students, particularly the underprivileged, for the foreseeable future.

3.3.1.2 The English language as a barrier to social mobility

In a recent article in a Sri Lankan newspaper, Prof. Hettige from Colombo University made the following provocative statement,

> Whether we like it or not, we need to recognize that there is a clear division in our society between a minority of English speaking elite and a majority of Swabasha – educated, monolingual youth. This division is continually reproducing a polarized education system. The Swabasha educated graduates do not have the communication skills and the confidence to compete with English educated youths. They do not apply for jobs that demand English language skills (Hettige 2008).

The situation Hettige (2008) describes is not simply a class issue or a symptom of an urban-rural divide although these factors are certainly relevant.

Tambiah (1986, p.74) asserts,

> Language has been the main bone of contention in Sri Lanka since independence because of its relevance for education as a medium of instruction and thereafter for employment.

Until independence in 1948 and thereafter until 1956, English was the language of administration. In 1955, Sri Lanka's Prime Minister, S.W.R.D. Bandaranaike, under pressure from Sinhalese Buddhist militants, claimed that 'if returned to office, he would effect the switchover from English in twenty-four hours' (Matthews 2004, p.64). His party swept into office on a nationalist platform and "The Sinhalese Only Bill" (formally the Official Language Act) was passed in the Sri Lankan parliament in 1956. The law mandated Sinhala as the sole official language of Sri Lanka. In 1958, the Tamil Language (Special Provisions) Act was passed which accorded Tamil official status in the North and East (Raheem 2006) of the country. These are predominantly Tamil and Muslim areas. In 1978, Sinhala and Tamil were declared National and Official languages and in 1987, English was given official status as a 'link language' (Raheem 2006). However by this time *swabasha* (mother tongue) had already become entrenched in the education system with students following either Sinhala or Tamil streams[29] – a system which largely remains in place until today.

With the mid to late 70's being an era of increasing liberalization of the economy and growth of the private sector, Sri Lanka started to experience the impact of globalisation. Corporate Sri Lanka tended to focus internationally and thus fluency in English became increasingly important.

This demand, occurring simultaneously with the switch to Sinhala and Tamil in the government system, led to the expansion of the system of international schools, originally put into place to cater for the children of expatriates, and whose existence Rotberg (1999) refers to as one of the most glaring inequities in the education system in Sri Lanka.

> International schools educate their students for the London G.C.E. O Level and A Level examinations or the baccalaureate, rather than for Sri Lankan examinations. However, the major inequity lies in the facilities provided. International schools charge tuition fees which are twice or three times the annual per capita income of the average Sri Lankan. The best of them provide sophisticated equipment and have attracted teaching talent. Their use of English as the medium of instruction (in contrast to government schools,

---

[29] Sinhala/Tamil medium education was phased in gradually to government schools. It ceased to be the medium of instruction for arts students in the 50's, for science students in the 60's and for Burghers (people of mixed Dutch or Portuguese descent) and Muslims by the early 80's (Wijesinha, R 2003, 'Bringing Back the Bathwater : New Initiatives in English Policy in Sri Lanka' in C. Mair (ed.), *The Politics of English as a world language : new horizons in postcolonial cultural studies*, Rodopi, San Francisco, California)

which use Sinhala and/or Tamil) has enabled their students to gain access to the best employment opportunities in the growing private sector (Rotberg 1999, p.118).

These developments disadvantaged the underprivileged youth of the island who had been schooled exclusively in *Swabasha* and whose families did not speak English at home, thus breeding resentment and frustration (Matthews 1995). In an editorial in the government newspaper, the Daily News in 1990, it was claimed that Sri Lankans had come to think of English as a sword, the *kaduwa.*

> English has always been a social killer, shedding no blood but maiming the many who did not have it (Daily News, Jan 4th 1990).

In the university sector, this resentment grew into an anti-globalization movement.

> [T]he Jathika Chintanaya ('national ideology' or 'way of thinking') movement first surfaced in 1984....Jathika Chintanaya identifies with cultural exclusivism and nationalism. Though somewhat diminished in the public attention it receives, Jathika Chintanaya is still a force to be reckoned with…. At its height in the late 1990s, Jathikha Chintanaya was popular on university campuses and among some elements of the urban elite and the *sangha*[30]….A chief target is the primacy of the English language, particularly in education, but also in business and politics. Knowledge of English is seen as the sword (*kaduwa*) that divides those with privileged backgrounds from the disadvantaged (Matthews 2004, p.63-64).

While the Jathika Chintanaya movement may have lost momentum,[31] the resentment of English remains, with individual students from time-to-time demanding that FIT revert to instruction in Sinhala.[32] However these representations do not appear to have the support of the majority who realise that English language fluency is key to entry into the corporate sector (refer to Chapter 6).

The government itself has changed its policy and has introduced English from the first year of school both to act as a link language between the Sinhalese and Tamil communities, to promote communication and understanding among the two, and to improve the capability of the future Sri Lankan labour force to work effectively in a global economy (IDA June, 2007). In 1999, English was made a compulsory subject for A/L finals although the scores are not added to the aggregate score for university entrance (Wijesinha 2003). Commencing in 2002, the government has introduced English medium instruction to some schools in the early years of secondary education extending up to G.C.E. O/L and up to G.C.E. A/L for Science subjects by 2007 (MEHE 2004). A recent news article reported that so far approximately 4,000 students from 115 schools have benefited from this scheme with the first batch under the program taking the A/L examination in English in 2007 (Associated Press, February 29, 2008). In the same report, it was noted that Cabinet had approved extending the opportunity for A/L students in arts and commerce streams to pursue studies in the English medium in schools where teachers and other facilities are available. It is expected that these measures will ensure that English language fluency will not be a barrier to success for the next generation of university students.

[30] The Buddhist clergy.
[31] While all universities require their undergraduate students to have a basic level of proficiency in English or to attend intensive preparatory courses organised by the English Language Teaching Unit (ELTU) of the faculty, the response to this varies with Janz (2008) reporting that the ELTU of the Arts Faculty at Colombo University have to contend with immense hostility.
[32] Madurapperuma, AP 2006, pers. comm., 16 April

3.3.2 Change Initiatives in the Education Sector

While all successive governments post-independence remained committed to the democratization of education initiated with the Free Education Act,[33] the anticipated improvements in the economy of the nation failed to materialize resulting in high levels of youth unemployment, widespread disillusionment amongst unemployed educated youth and the subsequent civil insurrections described above. The first of these occurred in April 1971 (Gunawardena 1991). In response, a series of reforms of the education system were introduced. The first of a series of curricular innovations was an attempt by the government to introduce a National Certificate of General Education for students at the end of Year 9 which would reinforce an innovative curriculum having a pre-vocational basis and greater relevance to the majority of students. However, because of public pressure to retain comparability with the earlier examination, the curriculum did not end up being very different (Gunawardena 1991). Additionally, there was no practical assessment because the public trusted the standard closed book controlled examination condition more than allowing teachers to assess their children (Gunawardena 1991). Also, despite statements that the new integrated science curriculum should emphasise the development of scientific concepts, patterns and processes rather than facts, the examination comprised a proportion of items testing knowledge higher than the average of the earlier papers (Gunawardena 1991).

In 1981 a White Paper on Education proposed some radical changes in assessment for the GCE which involved the inclusion of marks from continuous assessment[34] of project work by teachers in some subjects. Continuous assessment was accordingly introduced in 1987 but survived only one year. It was resisted by teachers because of their lack of preparation and by parents because of their mistrust of teacher judgements (Gunawardena 1991). The Janatha Vimukti Peramuna (JVP – Peoples' Liberation Front), leading a bloody insurgency at the time, demanded the abandonment of the continuous assessment reform on the grounds that it discriminated against the rural child. Little (1997, para. 33) quotes the Minister of Education at the time as saying, 'there was of course the JVP issue, but there was also resistance from some of the teachers. The private tutories would certainly have been losers and the University dons were divided. A section were strongly in favour; a section were strongly opposed'.

However, recommendations in the same White Paper for a life skills subject to help students in their transition to the world of work were better received. The subject was implemented on a pilot basis in 300 schools commencing in 1988 and phased in over a period of 5 years with 1000 schools joining the program every year. The reason this initiative was much better received than the earlier pre-vocational program was because sufficient resources were made available to support it, it was more

[33] The Free Education Act of 1945 was supplemented by the award of scholarships to able but needy children. At the same time, the establishment of 54 Madhya Maha Vidyalayas (Central schools), predominantly in rural areas, fully equipped with science laboratories, workshops and facilities for education at the senior secondary level was followed by the upgrading of hundreds of elementary schools scattered over the island to the level of senior schools in the 60s (Gunawardena, C 1991, 'Linking Education with the World of Work in Sri Lanka: The Experience of Two Decades' *Educational Review*, vol. 43 no. 1, p.79-89).

[34] Continuous assessment refers to marks being given for projects and assignments done during the school year as opposed to the traditional summative assessment mode where the entire mark for a course is awarded on the basis of the end-of-year examination.

manageable, it was introduced slowly, and because it was not an external examination subject (Gunawardena 1991).

From the early 2000's, moves have been made to 'shift from rote learning and didactic teacher-centred teaching, to student-based learning, [with] activities and projects introduced from the primary classes upwards' (de Mel 2007). In 1997 the NEC[35] recommended a change towards a competency-based curriculum and classroom based assessment at primary school level. These changes were introduced under the GEP2[36] project (1998-2005) with an emphasis on using informal methods and moving towards criterion-referenced assessment techniques (World Bank 2006). With funding from GEP2, the Ministry of Education (MOE) also introduced an English Language Action Plan to introduce English language learning from year 4 (World Bank 2006). Support for the extension of competency based education and school-based assessment to secondary levels has been provided under the SEMP[37] I and II projects (2000 – 2007 and 2005 – 2010 respectively) and will be extended under the EKSP[38] project (2008 – 2013) . EKSP will also provide facilities for teaching in ICT, English and technical subjects and will establish a Centre of Excellence in English Education to improve the quality of English Language teaching (iGovernment Bureau 2007). Various projects funded by the multilateral donor agencies (including SEMP I and II, and GEP2) have contributed to improving ICT facilities in schools. Under SEMP II, the MOE working with two local telecommunications providers are working to link most senior secondary schools and offices of education in a high bandwidth virtual private network (VPN) and to give schools access to innovative software tools for learning. This work will be continued and extended under EKSP.

3.3.3 The Context of Higher Education

The first milestone in the history of higher education in Sri Lanka was the establishment of the University College of Colombo in 1921 affiliated to the University of London (Warnapala 2009). The primary objective of the University College was to produce graduates for the administrative service and, as a result, the emphasis was on the arts and humanities (Warnapala 2009). In 1942, the Ceylon University College was merged with the Ceylon Medical College, and the science section of the Ceylon Technical College to form the University of Ceylon[39] with four major faculties - Arts, Oriental Languages, Science and Medicine. However, due to the influence of the Ceylon University Association who thought that the primary aim of the institution should be to revitalise and promote indigenous culture, it was the Arts and Oriental Studies faculties which dominated (Warnapala 2008b). In 1959, the Needham Commission argued for further extension of facilities for the study of Arts and Humanities. The Commission argued that it was 'the duty of a university to be the repository of the larger cultural heritage of all mankind and to transmit the spirit of that culture to succeeding generations'(Warnapala 2008b).

Training for employment other than the administrative service was largely the province of other institutions such as the Ceylon College of Technology established at Katubedda in 1966 following a Commission of Inquiry on Technical Education set

[35] National Education Commission
[36] Second General Education Project funded by the World Bank
[37] Secondary Education Modernization Project funded by the Asian Development Bank
[38] Education for Knowledge Society Project funded by the Asian Development Bank
[39] University of Colombo official web site : http://www.cmb.ac.lk/?page_id=138

up by the government in 1961.[40] This commission recommended the establishment of a new faculty of engineering as the only engineering education at degree level at the time was offered by the University of Ceylon, Peradeniya campus. The commission also recommended the establishment of courses in Commerce and thereafter every university began to teach courses in Commerce and Management (Warnapala 2008a). When all existing universities were incorporated into the University of Ceylon in 1972, the Ceylon College of Technology, achieved university status operating with just one faculty - the faculty of Engineering and Architecture. Under the Universities Act No. 16 of 1978 the Katubedda Campus of the University of Sri Lanka became an independent university with the name, University of Moratuwa with three faculties of study Engineering, Architecture and Town and Country Planning, and the Faculty of Physical and Applied Sciences (later to be amalgamated with the Faculty of Engineering).[41]

While courses at the newly established University of Moratuwa were clearly orientated towards employment, other universities continued to produce Liberal Arts graduates in great numbers who were not employable (Warnapala 2008a). The expansion of the university sector in the 60's and 70's in response to the demand created by the Free Education Scheme of 1945 aggravated the problem (Warnapala 2008a) as did the liberal economic reforms of the late 70's and onwards (referred to above) which reduced the size of the public sector. In the 70's the Osmund Jayaratne Committee on Higher Education tried to introduce a scheme of rationalisation, the aim of which was to rationalise the existing courses of study in the Arts and Humanities with a view to creating centres of excellence in respective subjects and giving an opportunity to expand faculties which were perceived as having a stronger link with the employment market. The Committee stated that what the country needed 'were not Government officials but economists, scientists and technicians' (Warnapala 2008b). This scheme of rationalisation was viewed as a Marxist conspiracy and created a lot of resentment among the academic community with the result that few changes were made (Warnapala 2008b) and graduate unemployment continued to be an issue resulting in the JVP-led civil unrest of the early 70's and late 80's referred to above.

The 80's were a turbulent time for universities in Sri Lanka with many universities suffering extended closures due to student unrest. The University of Moratuwa itself was closed for nearly two years in 1987 and 1988. This closure resulted in a backlog of admissions which, until 2007, had still not been completely cleared with the result that students accepted to the university sometimes have to wait for more than a year to be admitted.[42]

3.3.3.1 Moratuwa University and FIT (2004 – 2007)

The Faculty of Information Technology was established at the University of Moratuwa in 2001 and currently offers a BSc three-year degree (with an additional one year honours program by invitation), an MSc in Information Technology, an MSc in Artificial Intelligence, and a Bachelor of Information Technology by Distance Mode. The medium of instruction in all courses is English following

[40] University of Moratuwa official web site : http://www.mrt.ac.lk/history.php
[41] Ibid.
[42] Ibid.

university policy.[43] Recognising that many of their new intake are likely to have limited English language fluency, the faculty provides all students with a three month bridging course, which includes English language training, when they enter the university. Unfortunately, this did not happen in 2006 when a problem experienced by the University Grants Commission in handling enrollments resulted in a late start to the academic year and the three month program being cut to two weeks. Beyond this bridging course, students also follow a first year course, IT1002 (Communication Skill Development) and the faculty has additionally sponsored various informal initiatives including book clubs and English-language reading libraries.

Up until the start of this study, FIT was housed in temporary premises in Colombo. The primary drawback of these premises was a lack of green space for students (the building was essentially a converted office block) and a lack of facilities for small group work. The building comprised only two large lecture rooms each able to accommodate 50 students seated in rows, two computer laboratories (with around 60 operational computers connected to the Internet) and staff offices. A number of the facilitated team meetings in 2005 were held in the student common room. In facilitating team meetings and conducting tutorial sessions. The lecturer for Software Engineering was assisted by two other lecturers. With an enrolment of 49 students, each of the team facilitators were responsible for 3 or 4 teams.

In 2006, the University Grants Commission[44] doubled faculty enrolments overnight taking the enrolment from 49 up to 104 Students. The faculty moved back to the main campus of Moratuwa (some 30 minutes drive beyond the city boundary of Colombo) despite the fact that the faculty building there was still under construction and computer laboratories and lecture rooms had to be borrowed from the Faculty of Engineering putting pressure on teaching/learning space. The two available computer laboratories on the Moratuwa campus were similar to those in the Colombo campus with up to 40 computers set up in rows with little room to negotiate a passage should an instructor wish to speak to a student at the end of the row. Most lectures were conducted in two large lecture halls capable of accommodating up to 100 students seated in rows. At the Moratuwa campus, availability of space for small group meetings was so constrained that I had to hold meetings with small groups of students seated under a tree in the grounds and then only after the group had requested other students already using the seats to vacate them. At the same time, two of the three lecturer/facilitators from the first year of the study left to pursue higher degrees overseas. This combination of circumstances effectively precluded facilitated small group work.

There was, moreover, no opportunity to set up discussion lists or chat sessions to scaffold work on assignments in 2006 since the university was unable to provide an Internet connection to the computer laboratory for most of the semester. Hence a number of forms of support that were enjoyed by the first group were not available to the second. Connectivity problems were resolved towards the end of 2006 and the

[43] Universities in Sri Lanka are entitled under the constitution to make English the medium of instruction and many have done so. However some faculties elect to teach in Sinhala and/or Tamil-most notably faculties of arts and education.

[44] The UGC exercises central government functions such as overall policy formulation, rationalization of universities and degree programs, financing, student admissions and recruitment of non-academic staff.

new FIT premises, although still not completed by the end of the study, are planned with tutorial rooms to accommodate students.[45]

Of course, Sri Lankan universities are not alone in experiencing such problems as the result of political demands to increase tertiary enrolments. Savin-Baden (2000, p.143) notes a shift to teaching larger student numbers in universities in the UK and correlated 'management decisions to build larger and larger lecture theatres [which] has meant that there is less (if any) space for small group teaching, and little overall flexibility for courses that have adopted alternative teaching and learning methods to lecturing'. She moots the establishment of virtual learning communities as a solution to this issue but this solution is unlikely to be applicable in the Sri Lankan context with few students in public universities possessing personal laptops or the resources to benefit from online access.

Under this study, PBL was introduced to the BSc in Information Technology which is taught only in on-campus mode. Although delivered largely through traditional lectures, the BSc also lends itself to small group work with a major project to be completed on a team basis at each year level (Appendix C). In the first year, the project is 'IT1201: Digital Circuits and Devices' where students have to work together to apply their knowledge of digital circuitry to resolve a set problem. In 'IT2999: ICT Design Project', which occupies two semesters of the second year, students are expected to identify a business opportunity in the private sector where they can apply their knowledge of web site design / graphics, databases and programming to meet an industry need. The final year project, 'IT3999: Project' provides students with an opportunity to research an area of personal interest. Academic staff are expected to supervise student teams at each year level. After the third year, selected students are invited to enrol for an honours year. In 2005, the syllabus for the BSc was extensively revised in consultation with industry. This revised syllabus is included as Appendix C.

3.3.4 Recent reforms in higher education

Despite increasing enrolments in all universities and there now being 17 universities in the country, the public university system is only able to provide places for some 3% of the age cohort with the outstanding demand[46] for places being met by around 50 private institutions some 15 of which offer degree programs through affiliation with overseas institutions (World Bank 2007; Chandrasiri 2008).

In addition to this, there are a number of other concerns about Sri Lankan universities. The following points excerpted from a 2003 World Bank report into the sector (World Bank 2003b) provide a comprehensive summary,

- *Insufficient quality* with teaching and learning practices that do not encourage the acquisition of competencies and social skills demanded in the labour market and curricula which do not meet industry needs.

---

[45] Stage 1 of this building was later completed in August 2008.

[46] Accurate enrolment figures for private higher education institutions are not available but appear to be increasing. In 2004, the World Bank (World Bank 2004, *Treasures of the Education System in Sri Lanka*, press release, World Bank, Human Development Sector Unit, South Asia region, viewed 10th June 2007 at http://siteresources.worldbank.org) estimated the overall enrolment rates – covering students attending all public and private higher education institutions – to be 11%. A more recent World Bank Country Report (World Bank 2007, *Country Summary of Higher Education*, report, viewed 23rd November, 2007 at http://siteresources.worldbank.org) estimated the enrolment rate to be close to 18%.

- *High unemployment among graduates* which often leads to youth unrest compelling the government to periodically absorb unemployed graduates into the public service considerably in excess of actual numbers needed.
- *Lack of attention to social harmony and gender equity in the curriculum* compounded by language barriers which make communication and exchange of ideas between the different groups almost impossible.
- *Low student intake*
- *Inefficient admission* with students entering university approximately two years after they complete their A/Ls. This problem is compounded by degree programs often taking longer to complete than the nominated three or four years as a result of on-campus student political activism forcing university closures.
- *Weak administration*
- *Inadequate and non-performance-based financing* with allocation of funds based on historical patterns, rather than on current student numbers or other performance-based indicators related to teaching and research.
- *Absence of national quality control and monitoring systems* which makes it difficult for universities to assess themselves in relation to appropriate national and international standards.

Of direct relevance to this study are the nature of teaching and learning practices in universities. Poor pedagogical practices, limited training in teaching techniques and little recognition within the system for lecturers who commit time and effort to their teaching responsibilities are not factors likely to contribute to an environment receptive to new teaching approaches. The views of the World Bank in respect of limitations in teaching and learning practices are corroborated by the following excerpt from a labour market review conducted by the Asian Development Bank.

> (Sri Lankan) university programs are adversely affected by the shortage of fully qualified staff, many of whom have no postgraduate training or programmed staff upgrading..… Faculty promotion and tenure are granted without reference to classroom performance, teaching techniques or research outputs. On the whole, a rigid and outdated education system persists anchored on outmoded teaching and learning methodologies, rote-learning, lecture notes, traditional curricula, and inadequately localized textbooks (ADB 2000b, p.5).

Local researchers, Munasinghe and Jayawardena (1999) concur:

> In Sri Lanka, in designing academic programmes, insufficient attention is given to teaching, learning and assessments. The majority of academic programmes use conventional methods for teaching, learning and assessment. No attention is given to adopting modern methods. Academic staff are recruited mainly on academic qualifications, evidence of research and experience. However, their teaching ability is not tested. Even after recruitment, there is no effort made in staff development. As a result, academic staff lacks exposure to modern concepts in education, related to teaching, learning and assessments as well as other aspects such as course development…..There are well defined criteria for staff recruitment and promotion. The latter is mainly based on period of service and evidence of research work. Thus, there is no incentive to improve teaching quality (Munasinghe & Jayawardena 1999, p.72).

High levels of graduate unemployment are the most public indicator of the failure of the public university system to be responsive to market needs. The problem was first addressed by the Osmund Jayaratne Committee on Higher Education Prompted by the socio-economic implications of this issue, the government set up a Presidential Task Force on University Education in 1996 and, based on its findings, introduced a package of policy reforms for the university sector in the late 1990's (Chandrasiri 2008). Its major components included,

> [C]urriculum reforms, staff development, career guidance services, quality assurance and accreditation, and formulation of corporate plans and the introduction of the New Universities Act. Of these components, curriculum reforms were aimed at introducing more flexibility in the choice of courses for students, replacing end-of-year examinations with continuous assessment systems and the introduction of demand-oriented study programmes. It also includes the reorganization of external degree programmes and providing facilities to conduct courses in IT (information technology) as an essential component in degree programmes. The purpose of career guidance service was to improve the links between universities and the industry, and thereby enhance the employability of graduates. The main objective of the staff development programme was to provide an orientation in teaching and learning methodologies for probationary lecturers and short-term refresher courses for other teachers (Chandrasiri 2008, p.417-8).

As a result of these reforms, a number of Staff Development Centres have been established in universities (including the University of Moratuwa) with a view to improving the standard of teaching. While some of these are more active than others, there are, in my view, some excellent programs being run including annual conferences focusing on teaching-learning methodologies through the Sri Lankan Association for Improving Higher Education Effectiveness.[47] Some university authorities have also moved to forge stronger links with industry.[48]

Unfortunately most of the recommendations of the 1996 Task Force, drafted into the new Universities Act in 1999-2000 were never presented to Parliament. According to de Mel (2007), ‘political pressures prevented presenting this Act to Parliament and prevented the Ministry from implementing the changes proposed’.

Regardless of such setbacks, it should be acknowledged that there is, in fact, considerable flexibility for reform from within the university system.

> The public universities enjoy a high degree of academic autonomy. Curriculum development, standards setting, examinations, certification, and employment and promotion of academic staff, are within the discretion of each university. Central government functions, exercised chiefly through the University Grants Commission, are overall policy formulation, rationalization of universities and degree programs, financing, student admissions and recruitment of non-academic staff. In principle, the academic autonomy enjoyed by universities should ease problems of service delivery and enable the production of high quality teaching and research (World Bank 2004, p.49).

Course changes can be proposed through the Deans and the Heads of Department to the Faculty Board. The Faculty Board then submits the proposed changes to the University Senate. Both the Faculty Board and the University Senate are comprised entirely of academic staff. The Senate is supposed to seek the approval of a Standing Committee comprising academic representatives, industry members and other stakeholders and operating with the authority of the University Grants Commission (UGC). However, in reality, the Senate can force through a change even without this final approval (Munasinghe & Jayawardena 1999).

This brings us then to the question of how much, in this instance, is the level of support within the FIT for a change in pedagogy such as the introduction of PBL.

[47] http://www.slaihee.org/home/index.htm

[48] The University of Moratuwa has set up an Industry Interaction Cell to guide the maintenance of links with industry and has incorporated industry placements of 6 months or more into many of its programs.

3.3.4.1 Recognition of Issues and Level of Support for PBL among FIT Academic Staff

All faculty lecturers, other than the research team, were interviewed after the end of the baseline study in 2004. As described in Chapter 2, a convergent interview approach was used with the seed question being, "What sort of graduates should FIT try to produce and what is being done or can be done to achieve this?" Those interviewed were aware of the criticisms of graduates commonly made by industry and eager to make sure that their students avoided such criticisms. Their comments also reflected a high level of awareness of the problems identified in the baseline study although there was some difference of opinion as to whether students' weakness in communication skills was due to poor English fluency or not.

> We are trying to produce competent graduates for the industry here in Sri Lanka and also for foreign companies. They need to have good group dynamics when they work in industry……and they have to be able to do the tasks they are given within time limitations.
>
> (Lecturer, Academic Staff Interview 2005)

> The key criticism of the University of Moratuwa in general is that [the students] are not participating, they are not being able to participate in a team. So our target is for our students not to get that criticism and that is much more of a task than giving them knowledge.
>
> (Senior Lecturer, Academic Staff Interview 2005)

> Actually our students are very sound in technical knowledge; only problem is we are getting students from many districts of the country, so from outside say, Colombo and Kandy, we are getting a crowd who don't have the communication skills. The language barrier is the main problem for our students.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Notwithstanding their awareness of industry reservations about the quality of graduate soft skills, the level of support among FIT academic staff for initiating the development of such skills through targeted learning activities or changes to the learning environment, varied. The Dean at the time was fully supportive, but some of his senior staff were very concerned about compromising the coverage of technical content. Younger staff were keen to try the new approach – particularly those who had attended university outside Sri Lanka.

> PBL we thought is the way because that has all the characteristics to give us the environment to produce a whole professional rather than just a graduate knowledgeable in the subject.
>
> (Dean, Academic Staff Interview 2005)

> There the problem may be that when we are trying to introduce things onto that side [of soft skills], always the fear is there that the value attached to giving knowledge may go down. That problem is there. And that possibility is also there. The knowledge may come down to some extent and we have to make sure that that is minimal especially in the high tech areas. There, whether we like it or not, we will still have to keep to the conventional methodologies; "This is the book", "This is what I tell you", "This is the assignment you will have to do", "You will have to get high marks for this by cramming or whatever". That, I think we will have to apply because that is the thing that they might have to sell one day….this is going to be there for a while… but closer to management areas, it is useless for someone to get to know the theory because if you can't tell it to anybody, it is of no use. Those things, if someone comes down on technical knowledge of management we don't mind but our examination systems we will always have to have end-of-semester exams so there are a certain amount of technical or written questions that will always be there. But now we are having assignments as well, we can include the skills side of things especially in the management type of subjects.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Of course it should be remembered that similar reservations have been expressed by university academics world-wide making the move to constructivist learning approaches such as PBL a challenging one (Aldred et al. 1997; Brodie & Porter 2001; Monday & Barker 2003). Aldred et al. (1997) examining the implementation of PBL in subjects within professional education courses at The University of Queensland caution that,

> Clear vision at both the individual and school/departmental level is required, as is the leadership of individuals with personality, drive and commitment. This is particularly important when perceptions about PBL held by staff and students within any given institution are negative. There will always be individuals who resist change and who prefer teaching and learning to follow traditional structures in which the teacher is central. In making the paradigm shift to student-centered and problem-based learning, resistance from several quarters may be encountered.

In studies conducted in an Asian setting where the focus of the study was primarily on teacher/lecturer attitudes, similar concerns were noted. Fong et al. (2007, p.608) working with teacher educators in Hong Kong, found that,

> [A] consistently recurring theme in almost all discussions with the educators was their concerns about how much time and effort the PBL pedagogy would require. For example, they were concerned about how to assess the learning outcomes...Also, the teacher educators were worried about the steep learning curve during the adaptation to, and implementation of, a new teaching approach. This concern was intensified in the local context where the teaching professionals have a heavy teaching workload. Mastery of a new teaching method could only come with the accumulation of considerable experience and investment of time. While pre-service teachers could master new teaching concepts and ideas relatively easily, the prospect of having to master a new teaching approach could be daunting for some of the teacher trainers, their professional training being obtained in a traditional way in the past. Thus, the teacher trainers expressed their worry that they might end up spending more time on adopting a new pedagogy than on developing the students' subject knowledge to meet the rigid curriculum requirement.

At the University Medical Faculty in the UAE, negative perceptions of PBL on the part of the academic staff, resulted in a situation where, ‘the relative frequency of problem based teaching is decreasing and the Faculty is slowly but surely veering towards classical didactic teaching’ (Abdulrazzaq & Qayed 1991, para. 25).

However in other studies, including Asian settings, where there has been faculty support for PBL, the response has been largely positive. Khoo (2003) reviewing the literature on the use of PBL in medical schools in Asia noted findings of superior independent learning and problem-solving skills, increased enthusiasm for learning on the part of students, better staff-student relationships, improved reasoning ability, communication skills and better ability to work in small groups. Many of the studies that Khoo reviewed found that the role of the facilitator was pivotal and that participants in the PBL experience needed to be given adequate support.

In a Malaysian study, students had difficulty getting involved in discussions as the sessions were conducted in English which was a second language for many of them. Many students also reportedly felt that traditional, subject-based tutorials were more efficient for obtaining information. Barman et al. (2006) working with medical and dental school students in Malaysia found that most students found the PBL approach interesting but that some students worked harder than others to prepare themselves for PBL discussions. Students also felt that facilitators should promote more interaction between the tutor and the students as well as between students, and that clinical expert facilitators should give the correct answer when the students were in doubt.

In a study conducted at the Medical Faculty of the University of Colombo (Khoo 2003), only 50% of students found PBL motivating and a similar number agreed that they had acquired improved communication and problem-solving skills. Only 38% of students said that they enjoyed the sessions. About half were unhappy with the poor participation of their fellow students and found PBL time-consuming.

3.4 Student Perceptions – a Baseline Study

Having thus considered the background from which FIT students were drawn, the nature of the institution itself and some of the issues current at the time the study was conducted, what of the students themselves? A baseline study was conducted with 47 Software Engineering students in 2004, prior to any intervention in the course, to gauge student perceptions about the teaching-learning environment they found themselves in at FIT.

Of the students participating in the baseline study, 94% filled in a written Course Experience Questionnaire at the end of their course and 24 of them (51%) attended focus group sessions with a local market research company. All students participated in an in-class exercise designed to test their ability to apply the knowledge they had gained through their study. The in-class exercise was conducted in their Software Engineering classes but was not assessable. Copies of the Course Experience Questionnaire, focus group discussion guides and the in-class exercise referred to above are included in Appendix B.

The findings of the 2004 baseline study are presented below focusing in turn on each of the areas of concern identified in the original ICT Employer Survey - Problem-Solving, Teamwork, Communication and Independent Learning Skills.

3.4.1 Problem-solving Skills

Dissatisfaction with an education system orientated towards mastery of content rather than understanding was a recurring theme in student responses made during the study. Students revealed that their secondary schooling had strongly emphasised rote learning of content.

> When you start work you've not going to memorize things and do them; you're just given the resources and you've got to do it. …From year 1 to A/L we were doing that. Just memorizing things and going and writing just what ever we have learnt. But that stop for only one week. After that we forget and we start with the new work.
>
> (Participant, Baseline Focus Group 2004)

Unfortunately, their perception was that much of what they did at university, particularly in conceptual subjects such as Software Engineering, did not differ greatly from their experience at school.

> What we did [in Software Engineering] was a exam oriented study. So we didn't even gain any much of knowledge about that subject. Actually that subject is a subject where can gain a lot of knowledge and fundamentals in our IT career. But since we were totally exam oriented and the paper was also totally theory oriented what we did is the just memorise the theories, and just did the exam and forgot it.
>
> (Participant, Baseline Focus Group 2004)

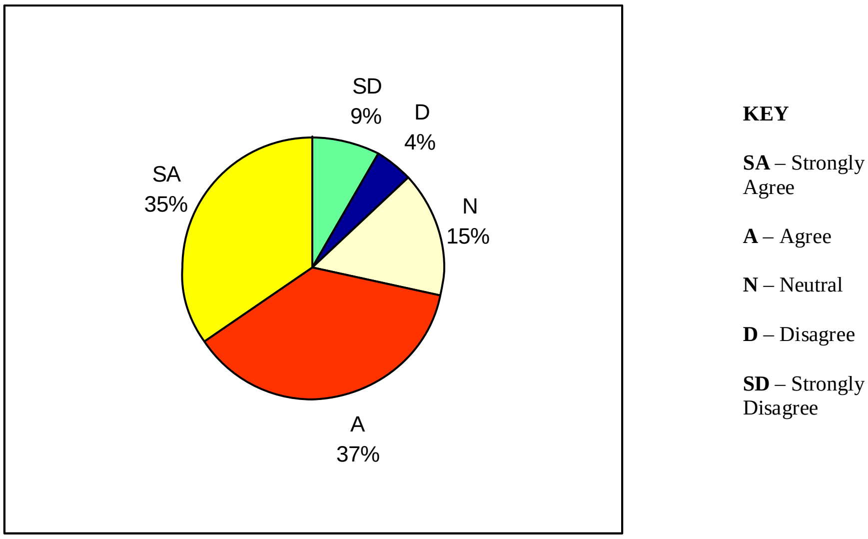


Figure 3.1: Student response (2004) to the statement, "*To do well in this subject all you really need is a good memory*".

As a result, 72% of those enrolled in 2004 prior to the introduction of PBL who responded to the Course Experience Questionnaire thought that *To do well in this subject, all you really need is a good memory* (refer Fig. 3.1) and 65% thought that *In this subject, I was tested more on what I had memorized than what I had understood* (refer Fig. 3.2). Less than half the students thought that *The subject was interesting and made me think, while* 50% agreed with the statement and approximately one-third (32.6%) were neutral (refer Fig. 3.3). Finally, only 41% thought that *Doing this subject has improved my problem-solving skills* (refer Fig. 3.4).

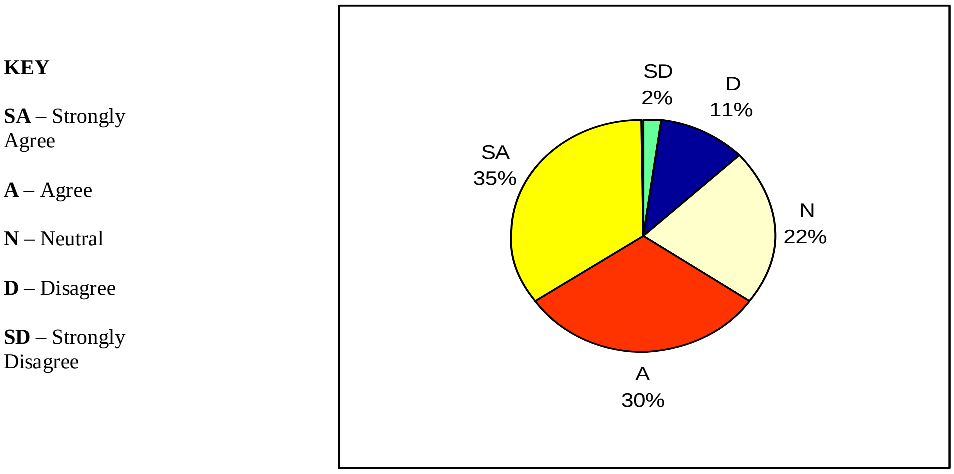


Figure 3.2 : Student response (2004) to the statement, "*In this subject, I was tested more on what I had memorized than what I had understood*".

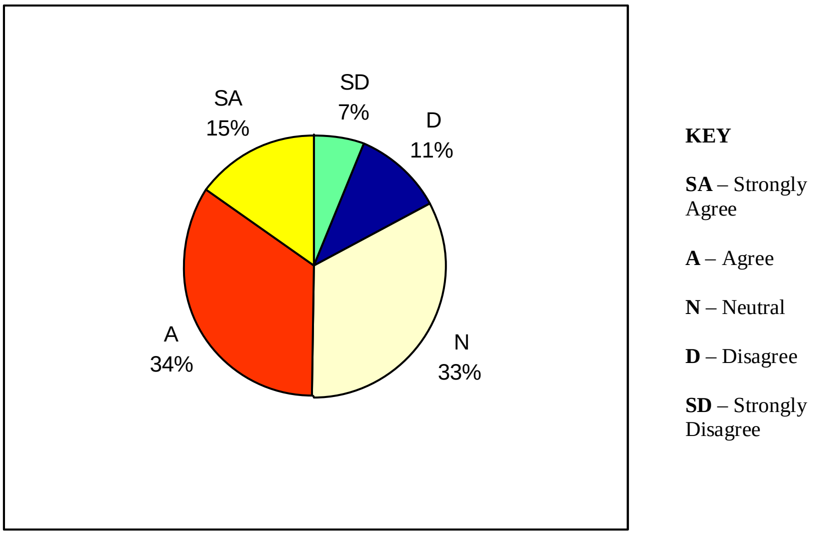


Figure 3.3 : Student response (2004) to the statement, "*The subject was interesting and made me think*".

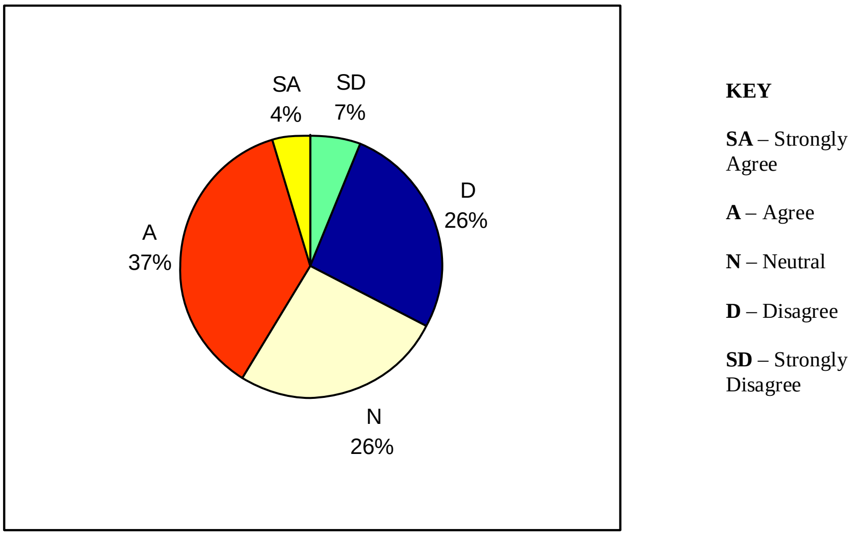


Figure 3.4: Student response (2004) to the statement, "*Doing this subject has improved my problem-solving skills*".

The latter finding (Fig. 3.4) is not surprising since it has been found that, in the sorts of didactic learning environments existing prior to the introduction of PBL in FIT, it is often analytical and problem-solving skills which are neglected. Bichelmeyer & Hsu (1999) note that, in emphasising the transmission of knowledge, the behaviourist mode of instruction often fails to develop the higher order learning skills essential for successful PBL.

Consequently, students participating in the baseline study were asked to complete the in-class exercise referred to above which required them to research material on the Internet and apply it to a case study analysis.[49] While the exercise was done on an individual basis with each student having access to their own computer, students were free to assist each other in the timeframe available – one 2 hour laboratory/tutorial slot. Those who completed the task (35 out of the 47 enrolled)

[49] Question for this exercise included in Appendix B (Exercise Title: 'LakSoft Proposal to InfoSVC Corporation and Empresas Española de Informática').

found this task exceptionally difficult. Their answers were full of direct and often inappropriate quotes from web sites (usually unattributed) and many failed to actually answer the case study questions appropriately. It was unclear whether they, in fact, understood the task that was required of them but feedback from their lecturer who was in the computer laboratory with them and the following comment made by a focus group participant, indicate that the exercise might have been beyond what is normally required of them to come to terms with in a single lab session.

> That was like, even we were able to refer the Internet and write the answer. We were like pretty shocked when we got the question, not ready for something like that and that was the first time we got something like that. Unlike most of the children were clueless on what is this question and so different to what we were told. That was some question to think about.
>
> (Participant, Baseline Focus Group 2004).

However, the reality is that, in an industry setting, software engineers are the problem solvers. They usually work in teams, often comprising representatives of both the business and the IT side of an organisation. These teams lend their collective experience to the design and implementation of systems – each one unique with its unique set of problems to be solved. If students finish a Software Engineering course without developing problem solving or application skills and instead with the impression that software engineering is just a set of abstract theories to be memorized, that course is not meeting industry needs and expectations.

3.4.2 Teamwork Skills

FIT students are frequently asked to work in teams, at least partly as a result of the emphasis on teamwork in the industry. Before they reach their second year and start the Software Engineering course in semester one, they will have worked in a team at least once to complete their first year project. However they are not provided with explicit guidelines on what good teamwork means nor are team leaders coached on how to lead a team. There is an expectation on the part of lecturers that students will 'learn by doing', or, in other words, that they will learn how to be good team workers through the experience of working in a team.

> Interviewer: What are you currently doing to give them these sorts of [teamwork] skills.
>
> Lecturer: Normally we are giving group assignments and there are group leaders. Therefore they are having some experience of managing groups and working together and achieving their targets from assignment and projects.
>
> Interviewer: So do you give specific training for this or is it 'learning by doing'?
>
> Lecturer: Yes, it is basically 'learning by doing'. When we give some software to be developed, they can divide the parts; some members can develop the interfaces, some can work with the core business and in this way they can get it done.
>
> (Lecturer, Academic Staff Interview 2005)

Our observations indicated that FIT teams in 2004 tended to function more like workgroups than real teams.

Pell (1999) describes an ideal team where,

> … each associate performs his or her function in such a way that it dovetails with that of other team members to enable the team to achieve its goals. By this collaboration, the whole becomes greater than the sum of its parts (Pell 1999, p.4).

whilst a workgroup,

> … is made up of individuals whose work is directed by a supervisor. The members do whatever they are assigned to do, and are measured by their individual performances (Pell 1999, p.5).

Students participating in the focus group conducted during the baseline study characteristically described their approach to working in a group as follows,

> Sometimes the others aren't interested in helping and then it is up to two or three of us. …..We chase them and scold them but in the end we have to. Otherwise our marks will suffer. It's up to the team leader. Sometimes he does all the work.
>
> (Participant, Baseline Focus Group 2004)

However, it became evident over the course of the study that a failure to contribute to teamwork was not always due to team members simply abrogating their responsibilities. In many cases, a team leader would only invite his/her team members to contribute to an assignment where they were perceived to have pre-existing expertise or experience. Less able/experienced students were sometimes not given an opportunity to contribute at all as this comment from a 2005 focus group participant illustrates,

> Also sometimes we feel it's better doing it on our own rather than giving it to someone else who might mess it up. Otherwise everyone will lose points if it's wrong. If I know someone doesn't know it and it is much better if I do it then I wouldn't think of giving it to him
>
> (Participant, Focus Group 2005)

Finally, a student's reflection on teamwork submitted in 2006 shed some further light on the dynamics of groupwork:

> Though few were committed, it is rather embarrassing to mention that some group mates neglected their responsibility and made the life difficult for the people committed. We came to know the neglecting was done not because they really want to, but they were afraid that they will mess the whole thing up as they had no confidence on them.
>
> (Student Reflection, 2006)

From these comments, it may be surmised that students are merely following the role models available to them (that of the workgroup) and competing for the highest grades, as best they can, given the context of having to work in a team. With the exception of the IT industry (which, in Sri Lanka, tends to derive most of its income through offshore outsourcing[50] and accordingly adopts an international management and work culture), there are few good role models of teamwork available to these students. Weathersby (1993), conducting research on local management styles while acting as a visiting professor at the Postgraduate Institute of Management of the University of Sri Jayawardenapura, concluded that,

> Sri Lankan leadership styles are traditionally authoritarian. They have evolved from the ancient practices of able and autocratic kings, upon which the Portugese, the Dutch, and the British imposed a bureaucratic colonial administration. Social class, caste, religious and educational differences are powerfully present, although their effects are lessened in contemporary workplaces. The work ethic for ordinary workers is greatly relaxed when compared to that of the United States and other industrial democracies. There is also a tradition of political influence in jobs and appointments…..In most situations, managers are expected to rule by coercive and reward power. Whereas the developer manager [her American role model] is anti-heroic, the Sri Lankan management hero is the hard task master or benevolent dictator (Weathersby 1993, p.71-73).

[50] Offshore outsourcing is the process of subcontracting work to an overseas organisation, often as a cost-saving measure.

Weathersby's conclusions are consistent with other studies which attribute a high Power Distance Index (PDI)[51] to South Asian cultures and is also reflected in the organisational structure and operation of the university. PDI refers to the equity of the distribution of power within a society. In a country with a high PDI, it is accepted that power is distributed unequally and this is true for the family, the school and the workplace (Marcus & Gould 2000). It is only natural with such role models and in such a cultural setting, for a group to adopt a workgroup approach with a supervisor or team leader expected to allocate work, manage his/her team, and take full responsibility for delivery of the finished product. In such a context, it cannot be assumed that simply by allocating students to teams they will somehow discover good teamwork skills. The task over the period of this study then becomes one of providing students with a different vision of what it means to be a team.

The fact that Sri Lanka, like many Asian nations, retains a collectivist culture (Freeman 1997; Chandrakumara & Sparrow 2004) should provide a good foundation for team work. Although Freeman (1997) discovered significant variations within the Sri Lankan culture with high socioeconomic status, urban residence, overseas experience, and English language fluency all tied to a more individualistic outlook, FIT students tend to score low on all of these indicators being generally from poorer families from the rural hinterland with limited English language fluency (see 'Communication Skills' below) and limited exposure to western cultures. They can hence be expected to retain a collectivist disposition. In collectivist cultures people have close ties to the group and take responsibility for fellow members of that group (Marcus & Gould 2000). Where this carries over into a learning environment, it will naturally have positive implications for group work. In a comparison of fourth year medical students of Asian and Anglophone backgrounds in an Australian medical school, it was found that there was greater emphasis within the Asian sample on values such as belonging to a group, and on co-operation rather than competition or interpersonal recognition (Khoo 2003).

Given this, it was anticipated that FIT students using PBL might enjoy working in groups despite their years of intense, individual competition through high school. and that there might, therefore, be the potential to build a base for solid teamwork on this collectivist foundation.

3.4.3 Communication Skills

It is university policy that lectures should be given in English and this is problematic for some students. The problem of using English as a medium of instruction is compounded by the length of lectures (three hours at the time of establishing baseline data). The English language requirement is designed to make graduates competitive in the business arena where many corporations have links to overseas offices, conduct the core of their business in English and, accordingly, tend to prefer graduates educated overseas or from the urban elite who usually speak English at home (Bandarage 1998; Hettige 2000).

As mentioned above, the government has recently introduced new policies to promote the teaching and learning of English from Grade 1 upward. However, for the moment, the majority of FIT students have attended government schools and have been schooled in *swabhasha* or mother tongue and, for them, English is a second

[51] PDI is an index formulated by Geert Hofstede in his seminal work studying IBM employees in 53 countries between 1978 and 1983. Although Sri Lanka is not yet included in the list of countries surveyed by Hofstede, India and Pakistan have been.

language in which many have limited fluency. Suddenly being faced with instruction at tertiary level, in the English medium, presents many of them with a real challenge. Students in the baseline study focus groups, estimated that their classmates generally understood only between 50-70% of the English in lectures and less towards the end of long lectures.[52] This is consistent with the findings of studies conducted with international students in UK universities, which suggest that, even where students are superficially fluent in English, 'aural comprehension skills may not be sufficiently developed for coping with extended periods of listening such as in lectures and the students may tire easily' (Cammish 1997, p.144). Just like their counterparts overseas, lecturers at Moratuwa also battle with many of the common traits of bilingual learners including a tendency to plagiarise, an unwillingness to try to summarise or paraphrase material because of a lack of confidence with grammar, and a tendency to try to get by through memorizing in situations where English language communication is required such as in class presentations, and oral or *viva voce* examinations (Cammish 1997).

Cammish (1997, p.146-7) noted that students studying in a second language,

> … may again fall back on [the technique of rote learning] when tackling examinations, learning whole examination answers by heart, even though they no longer need to do so. Students from countries where rote-learning is a traditional part of education or religious training may be particularly good at this and may take time to adapt to the different academic culture prevalent in British universities. A group of South-East Asian students interviewed about this confessed to carefully preparing essay answers in advance and then, by prodigious feats of memory, reproducing them in the examination, solely because they were frightened that under examination conditions, their English would be inadequate.

At FIT, this practice of rote learning to compensate for poor English language fluency is glaringly obvious in student team oral presentations where students who have convincingly presented a section of their team's report to the class are unable, 10 minutes later, to answer the simplest question about the material just presented. Invariably, a fellow team member will jump to answer the question for them. A focus group participant explains,

> If there is someone who knows English well, then we give preparing the presentation to them. Some group members we have to teach what to say and then they memorize and give their part.
>
> (Participant, Baseline Focus Group 2004)

Clearly students who are coping with class presentations only by memorizing material prepared for them by their peers, are unlikely to be able to master the presentation and communication skills that these exercises are designed to teach and which are demanded by industry. This is evidenced in the results of the 2004 baseline course feedback survey where only 24%[53] of students agreed that, *My spoken communication skills are better as the result of doing this subject* (Fig. 3.5).

[52] 2004 Student Focus Groups.

[53] 11 of 46 students completing the Student Course Experience Questionnaire (out of a total enrolment of 47) said that they Agreed or Strongly Agreed with this statement.

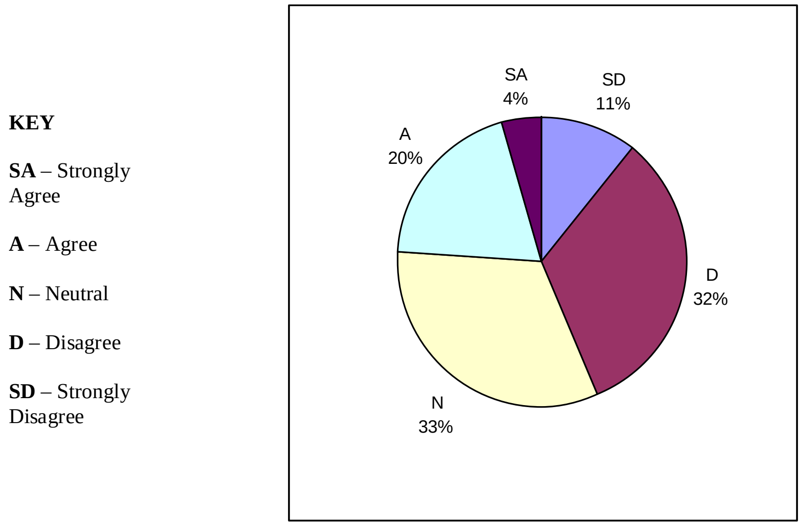


Figure 3.5: Student response (2004) to the statement, "*My spoken communication skills are better as the result of doing this subject*".

One interesting student strategy for coping with a lack of English skills is the *Kuppi*. The *Kuppi* is an informal, small group tutoring session conducted in Sinhala or Tamil and led by a capable student from the same year group or possibly a senior. In response to the 2006 Student Course Experience Questionnaire, students rated participating in *Kuppi* as the second most important learning activity after self-study (and well above attending lectures). An excerpt from a focus group interview conducted during the 2004 baseline study gives some insights.

> <u>*Moderator*</u>: You are saying that you don't understand the lecture. So why not ask.
>
> <u>*Participant*</u>: We are scared …and ashamed too. Better to ask someone from the batch. Lots of times someone from the campus teaches us….it's called a *Kuppiya*. Some subjects can be totally done in this way.
>
> <u>*Moderator*</u>: What do you mean by *kuppiya*?
>
> <u>*Participant*</u>: A person in the batch or a senior teaching us what we have done in Sinhala.
>
> <u>*Moderator*</u>: Why do you have so much confidence in this *Kuppiya*? Is it so sure?
>
> <u>*Participant*</u>: It was never a failure. For the exams we have had up to now, I've used it and there's no reason not to believe in it.
>
> <u>*Moderator*</u>: Is it actually like a discussion then?
>
> <u>*Participant*</u>: Yes. One person does the lecture and since he's a friend, we ask questions so it becomes like a discussion. Even if we are laughed at, it is OK because it's friends and our people, so we can ask anything.
>
> <u>*Moderator:*</u> So the gap that exists in the lecture room goes at this point?
>
> <u>*Participant*</u>: Yes.
>
> <u>*Moderator*</u>: Why can't we build this sort of atmosphere in a lecture?
>
> <u>*Participant*</u>: Most times the language matters. Also we respect the lecturer.
>
> (Baseline Focus Group, 2004)

There are two main points to be taken from this excerpt. The first is, of course, the language issue. The second is the evidence of Power Distance in the relationship of students with their lecturers. With some lecturers, this results in a reluctance on the part of students to ask questions in lectures lest it be construed as an implicit criticism of the lecturer's presentation. While such feelings were less evident in the beginning of the study when the faculty was quite small and intimate, it became more of an issue when class sizes doubled in 2006 and the faculty moved out to the main Moratuwa campus.

> Lecturer: So one thing is by introducing PBL so it is a good time to be doing that. So that the students can interact more so they can get close to the teacher, that is the thing that might work. At the moment they don't know who we are. They think only [lecturer's name] he is a senior lecturer, he is a professor. There is a very big gap between the lecturer and the student so they don't want to come close. We have to break the barrier.
>
> Interviewer: So why is this a problem?
>
> Lecturer: They don't ask questions. So that is the problem.
>
> (Senior Lecturer, Academic Staff Interview 2005)

This gap between students and lecturers is quite common in the public university sector and was also noted by Gunawardena (1998, p.105) working in the Open University in Sri Lanka.

> [I]ndia and Pakistan scored moderately high on Power Distance, which is the degree to which a society accepts the idea that power is to be distributed unequally. Goodman (1994) notes that these societies are characterized by teacher-centred education, in which the teacher transfers wisdom to students. Students are not expected to initiate communication or speak up unless called upon to do so. In such societies teachers are respected in and out of class and are not to be publicly contradicted. Age is respected and formal presentations such as lectures are appreciated. This to a certain extent describes the socio-cultural context of the Indian sub-continent.

Khoo (2003, p.402), noted the same factor in students who are 'enculturated from a young age not to be outspoken in front of any authoritative figure' as a PBL-incompatible Asian cultural attitude.

> Ho et al. (2001) have also argued that Asian students lack passion for what they study. They expect the teachers to tell them exactly what to read and assign clearly defined tasks. They do not ask questions and seldom participate actively in class. In discussion groups, Asian students also take a long time before they will speak.... So in an educational setting, these behavioural characteristics of Asian students fit in with the traditional view of the teacher imparting knowledge while the student just listens passively (Khoo 2003, p.402).

Consistent with these analyses, only 15% of students responding to the baseline Course Experience Questionnaire agreed with the statement, *I often made comments and asked questions in lectures* (Fig. 3.6).

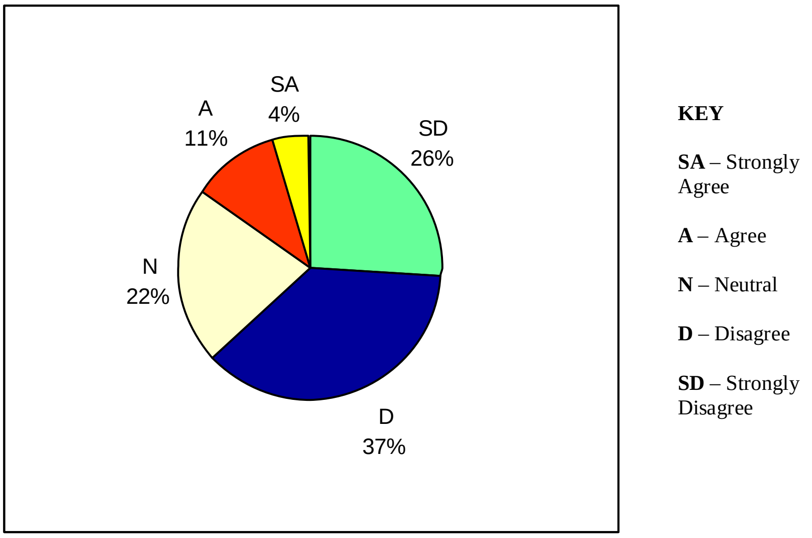


Figure 3.6: Student response (2004) to the statement, "*I often made comments and asked questions in class*".

Lack of English language fluency then becomes a problem which manifests itself in many ways. Firstly, as a challenge that must be overcome to meet the expectations of employers and to enable graduates to compete with the urban elite for jobs. Secondly, as a barrier between students and lecturers in the lecture room (although lecturers normally communicate with their students in Sinhala outside lectures or in Tamil for those few lecturers fluent in the same). Thirdly, as an impediment to understanding the lecture itself. Fourthly, as a disincentive to communication with peers from other ethnic groups. And finally, as an obstacle to understanding the textbook and other support materials (see following section on 'Learning to Learn'). The bridging course in English provided by the faculty for those enrolling in first year is clearly not enough. For those with limited English fluency on entry, the problem is more fundamental than simply not having good enough communication skills to compete in the job market. Their lack of English fluency impedes their learning at every level.

3.4.4 Learning to Learn

Students come to FIT having experienced many years in very traditional, didactic learning environments.

> To start with, we will go back to the person we are asked to take in whose skill is basically 13 years of studying at school, teacher directed, with a lot of listening and writing down answers and a little bit of practical as well. Theoretically they also do projects but not that much of projects.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Once at university it is largely expected that they take control of their own learning. Naturally this presents them with a challenge.

> In our A/L's we had good teachers who were coaching us and who were showing the path. But when we come to University the entire thing changed. We were expected to change our culture over a night. So I think the first two semesters should have been nearly like A/L. It should have been done in a reducing manner. So that when you came to the second year, you get the ….say…technique of how to learn by yourself.
>
> (Participant, Baseline Focus Group 2004)

It was evident from this and other focus group responses that, despite a lifetime of academic study, FIT students still needed to develop self-study skills. The study skills taught to them during their schooling and at the tutories encourage teacher dependency and rote learning. Students spend tutory sessions being told why a certain answer to a probable exam question is correct or incorrect. They are not encouraged to undertake any active learning for themselves.

The problem is of course compounded by the use of English as the teaching medium and, I would argue, by the selection of a textbook for Software Engineering which, in my personal assessment, employs a highly conceptual presentation of material using very formal language likely to be challenging for those for whom English is a second language. Various editions of this textbook had been used since FIT started operations, and despite student comments such as the one below and my direct request, faculty senior staff were reluctant to replace it.

> But software engineering is not easy for us to learn alone. We don't know anything. We don't understand what we read [in the text book].
>
> (Participant, Focus Group 2005)

One might expect, given the collectivist culture established above, for there to be an opportunity for collaborative learning in teams. There is, in fact, some evidence of this,

> Doing the group work assignments [was the most useful activity in the course]. Then we can discuss and get ideas about others. When we are doing assignments individually we write only what we know. Sometimes what we think is correct today, after talking with others, I realise it's wrong.
>
> (Participants, Baseline Focus Group 2004)

However, the experience of others who either choose, or are told, not to contribute to team assignments because of a fear that their contribution would decrease the quality of the finished product (refer to Section 3.4.2 above), can only be described as a negative learning experience and one very unlikely to result in collaborative learning. Moreover, the habit of individuals taking on parts of team assignments only where they already have expertise (refer to Section 3.4.2 above), is unlikely to result in exchange of knowledge or building of new skill sets.

Again, students seem to be falling back on known role models. Having been challenged to take control of their own learning, they seek out *Kuppi* which resemble a classroom setting with an expert and learners, albeit a much more interactive one than students might have experienced in formal education settings. Although some 50% of students in the 2004 baseline study responded to the Course Experience Questionnaire by saying that they were confident they could *learn a computer package on my own (not going to a formal course)*, this probably would not satisfy employers who are expecting all whom they recruit to keep themselves up-to-date on the latest technologies. The challenge appeared to be to equip students not only with the skills to self-learn but also with the confidence to take this path over another where they were dependent on an "expert".

3.4.5 Awareness of Industry Expectations

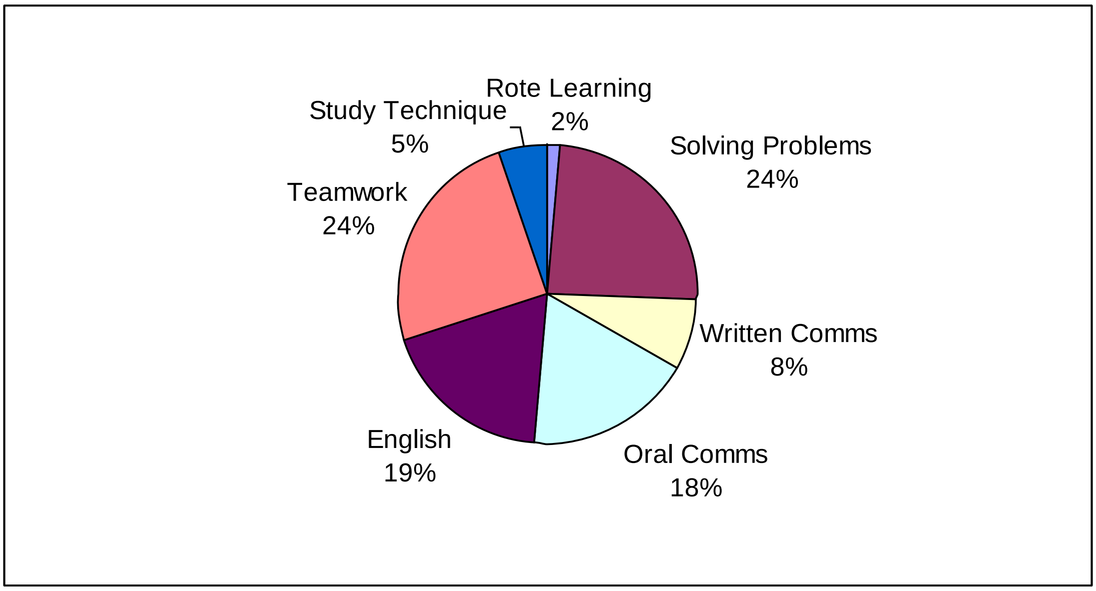


Figure 3.7 : Student perceptions of soft skills important to employers as expressed in 2004 focus group sessions

In order to gauge the extent of student awareness of what skills their potential employers might be looking for, focus group participants were asked to draw a pie chart to show how important each of a number of graduate skills would be to a potential employer. The results, as summarized in Figure 3.7, demonstrate a high level of awareness of the range of employer expectations of graduates.

However the breakdown of skills perceived as important for success at university (Fig. 3.8) was very different, with rote learning and study technique being rated equally with other skills. This suggests a measure of incongruity, at least in student perceptions, between the skills being developed at university and the skills required by employers.

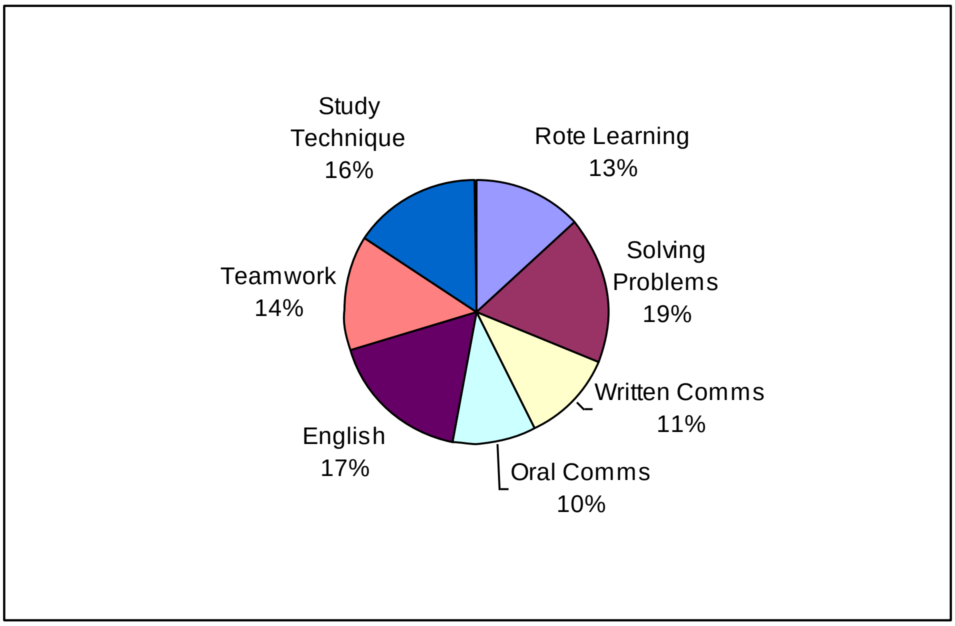


Figure 3.8 : Student Perceptions of key success factors for university as expressed in 2004 focus group sessions

3.5 Implications of the review of context for the design of the initial intervention

It is apparent that the didactic teaching-learning environment to which these students have been exposed throughout their secondary schooling and, too often, also at university, has ill-equipped them to be problem-solvers or to work as a team. While many students claim to dislike rote-learning and say that they would like to be challenged in their learning, it was apparent from the results of an in-class exercise that few had developed the ability to apply knowledge.

Similarly, whilst the Sri Lankan culture might have a collectivist foundation, years of intense competition with their peers starting in primary school have made it difficult for these students to work and learn collaboratively. The absence of good role models for team work and a lack of training in teamwork skills compounds the problem. It is unlikely that expectations expressed by lecturers that students would develop teamwork skills, though the experience of working in groups can be realized in the absence of such role models and/or training.

Nonetheless, there are indications of potential for collaborative learning particularly as evidenced in the popularity of *Kuppi*. Student preference for studying in groups (or in a *Kuppiya*) rather than individually can be seen as a foundation on which a collaborative learning environment could be built. However, this foundation needs to be replicated in the formal learning environment as well as the informal. A major obstacle to this would appear to be the power distance between the students and their lecturers particularly where age or seniority create a perceived barrier of respect. There are some indications of *Kuppi* being run as alternative lecture sessions. To avoid this and to build on the collaborative learning potential of the *Kuppi*, it might be beneficial for students to have some training in study skills.

Finally, lack of fluency in English emerged as a central issue with ramifications for understanding material presented in the lecture and in the textbook, for learning from class work including assignments and presentations, and for interpersonal communications.

Whilst recent initiatives by the Sri Lankan Ministry of Education to address the development of higher order learning skills and English language fluency are likely to obviate such problems for the next generation of students, more immediate solutions need to be found for students currently enrolled in public tertiary training institutes to allow them to compete on an equal basis with those of their age cohort who might have had the advantage of attending private schools or even studying overseas.

As can be seen from their comments above, FIT academic staff are generally aware of the issues emerging from the baseline study, particularly the lack of teamwork and communication skills but are divided on whether communication problems stem from a general lack of communications skills or is an English language fluency issue. They are also aware of the importance of soft skills to potential employers. However, many are concerned about any change to the syllabus which would compromise the coverage of technical content. Against this background, it was necessary to come up with a study design which did not threaten the status quo, pending the emergence of supportive data to make a case for more far-reaching change.

> We have to slowly bring it in because we have lots of obstacles to overcome, one is the student mentality, they are not used to this learning by themselves environment, even if they are guided by the staff. The other problem we are having is our staff are new to this methodology as well – they need adaptation time. So what we do is we take part of the lecture-based content delivery, and we make the assignment part more problem-based so that we get the best of both worlds so that we don't disappoint the students from their traditional expectation but gradually bringing in this other part.
>
> (Dean, Academic Staff Interview 2005)

The following chapter describes the design for the initial intervention based on the analysis of context presented in this chapter.

CHAPTER 4

Initial Design Phase of the Learning Initiative (2005)

Based on the analysis of context presented in the previous chapter, it was decided to selectively target particular graduate attributes in this first phase of the design intervention. These included teamwork skills, problem solving skills, English language and communication skills, and independent learning skills. As a result, the initiatives trialed in the current body of research are targeting improvements in these areas. Because of faculty reservations about any changes which might threaten coverage of the technical content, changes needed to be made incrementally. Hence in this first phase, the intervention was designed to pilot the introduction of PBL under existing constraints - these are described in the next section.

4.1 Operating Constraints

Firstly, I was constrained to working within one subject area even though proponents of PBL would generally advocate working across disciplines (Aldred et al. 1997; Conway & Little 2000; Dixon 2000; Savin-Baden & Howell-Major 2004). In fact, Dixon (2000, p.43) goes so far as to state that, 'A specialist-dominated PBL curriculum risks becoming as constraining as a conventional, didactic approach'.

Secondly, the available learning space did not support small group work. The facilities available at each of the campuses have already been described in the previous chapter. The claim by Aldred et al. (1997, p.9) that, 'The physical architecture of any learning institution mirrors its philosophies of learning and teaching' would seem to be particularly pertinent.

Finally, the faculty ruling was that at least 60% of marks had to be allocated to examinations (refer Table 4.1). Unlike assignments, examinations had to be submitted to a senior lecturer for approval. As examination questions tended to measure content knowledge,[54] the heavy weighting on tests encourages students to prioritise mastery of content.

Table 4.1 : Assessment Scheme for Software Engineering (2005)

Assignment 1: Team Web Page & Individual Profiles	5%
Assignment 2: Software Process Models	10%
Assignment 3: SRS Documentation	20%
Reflections	5%
Mid-semester Examination	10%
Final Examination	50%

Given these constraints, it was necessary to design a hybrid course for Software Engineering. Weekly two hour tutorials were introduced where students participated in a series of learning activities designed to build skills (such as teambuilding or presentation skills) required to support them in undertaking their PBL assignments (refer to Table 4.2). The PBL assignments themselves were structured around

[54] Examinations are often marked by junior staff so the preference is to use multiple choice questions and short answer questions for which a strict rubric can be provided.

problems which challenged students to utilize available knowledge resources such as material presented in lectures, reference material provided during tutorials and other material researched personally by team members using predominantly online resources. PBL tutorial groups were led by lecturers acting as facilitators. Assignments were done by student teams with a group grade given by the lecturer and moderated through peer assessment. The weekly three hour lecture was retained with the lecturer using this opportunity to assist students to clarify their understanding of the lecture material which was made available online in advance of the lecture.

Proponents of PBL might well be critical of such an approach. In fact, Marincovich (2000, p.9) quotes Professor C.Y. Kwan of McMaster University as likening using PBL to enhance the traditional lecture format to ‘using a sliderule to aid computer calculation’. However, Lai and Tang (2000) working in the Hong Kong education system which, being examination-oriented and characterised by a didactic teaching approach, has a number of similarities with that of Sri Lanka, recommend that, ‘Some forms of hybrid PBL models might have to be considered, at least at the introductory phase so as to gradually reduce the gap between students' previous learning experience and the type of learning nominated by PBL’ (Lai & Tang 2000, p.187). As well as making the transition easier for students, it was hoped that the hybrid trial of the design would act as a “proof of concept” encouraging the faculty to adopt the PBL approach more closely.

In the meantime, relevant lectures and skills training sessions were presented to students as learning activities related to their PBL assignments. Lectures not directly relevant to the PBL assignments, provided the context of Software Engineering. Perrent et al. (2000, p.345) see a valid role for lectures and skills training activities used in this way stating,

> In its original form, a PBL curriculum is delivered in a set of problems which provide the starting point for the learning process. Problem-based learning constitutes the backbone of such a curriculum. Other educational methods such as lectures and skills training are present, but only to support PBL.

This chapter presents the design of the initial intervention to the second year Software Engineering course, investigates the learning theory that guided the design, and explains the influences of established theory on this. In so doing, the advice of Gorard (2004) was heeded :

> While the structure of a complex instructional tool or intervention may be considered an embodiment of a local theory, unless that structure is made explicit, and the propositional framework upon which the design rests laid bare, it does not constitute a test of that theory, and therefore contributes little to the broader body of disciplined knowledge about teaching, learning, or anything else (Gorard 2004, p.107).

Table 4.2 below presents the course structure excluding the weekly lectures. The initial objective was to establish a good team spirit. Thereafter, student teams were challenged to apply their knowledge of the course content to the resolution of real world problems. As they experienced demands to demonstrate mastery of soft skills such as oral or written communication skills, skills-building tutorial sessions were convened.

Table 4.2: Overview of Course Design

WEEK	ACTIVITY
1 → 2 → 3	Introduction to PBL. Setting up teams and an introduction to teamwork and meeting skills in facilitated tutorial sessions. Assignment 1 (designing a team web site) set as teambuilding exercise.
4	Assignment 1 due date – web sites to be uploaded to faculty CMS
5 → 6 → 7	Assignment 2 set as PBL exercise to build communication skills and ability to apply the content knowledge of the subject. Supporting tutorial exercises on study skills and communication / presentation skills.
8	Assignment 2 due date – group presentations given in front of peers and lecturers.
9 → 10 → 11 → 12	Assignment 3 set as PBL exercise to build application skills in a real-life situation. Supporting tutorial exercises on Internet research and written communication skills. Student meeting with industry client outside university. Concept of reflections introduced. Students write reflections on teamwork and learning.
13	Assignment 3 due date – written report to be uploaded to faculty CMS.

4.2 Situating the Intervention in a Problem-based Learning (PBL)Framework

The intervention was designed within a PBL framework for two main reasons. Firstly, and primarily, a PBL approach seemed most likely to engender the sorts of graduate attributes employers surveyed in the first year of the study said that they wanted, while at the same time supporting the development of higher order learning skills.

PBL is a constructivist approach in that the learner constructs knowledge by interacting with the problem situation, the resources at his/her disposal and with his/her peers (Bichelmeyer & Hsu 1999).

> Constructivist educators strive to create environments where learners are required to examine thinking and learning processes; collect, record and analyse data; formulate and test hypotheses; reflect on previous understanding; and construct their own meaning. The constructivist sense of "active" learning is not listening and then mirroring the correct view of reality, but rather participating in and interacting with the surrounding environment in order to create a personal view of the world. Constructivists engage the learners so that the knowledge they construct is not inert, but rather usable in new and different situations (Jonassen et al. 1995, p.11).

Constructivists claim that it is only through internalising knowledge by using past learning and experience to confer meaning on it (assimilation[55]) and by then using the newly acquired concepts to solve new problems or to explain to others (accommodation[55]), that the learner learns (Fosnot 1988 cited in Stacey 2005). This cycle of assimilation and accommodation, referred to elsewhere as deep learning (Taylor & Burgess 1995), results in knowledge that can be applied outside the immediate context. It is this ability to use one's past experience and accumulated knowledge to resolve new and unique problems that Sri Lankan IT employers surveyed in 2004 said they are looking for.

The alternative, surface learning, or what Paiget termed "imitative accommodation" (O'Donnell 1999), results when something is memorised or when students learn to give the answers they think their instructors want to hear. In the words of one focus group respondent, this knowledge 'stop for only one week. After that we forget and we start with the new work' (Pers. Comm., Participant, Focus Group 2004). Surface learning is often associated with didactic teaching-learning environments (Topping 1998) emphasising coverage of content - precisely the environment FIT students claimed to have experienced at school and even into university.

> Didactic curriculum delivery, coupled with crude and brief summative assessment methods, are known to promote a surface approach to learning - the kind of learning of which machines are now capable - rather than a deep or intelligent approach (Topping 1998, p.2).

It can be argued that an exclusive focus on coverage of content is inappropriate at this level of education and particularly in the rapidly changing field of ICT (Dixon 2000; Marincovich 2000). Admittedly Sri Lankan employers of IT graduates are more concerned about content knowledge than Australian employers (Madurapperuma & Macan Markar 2006), but the general consensus is that content can be expected to become outdated quickly necessitating ongoing professional upgrading of knowledge, while the need for problem solving and analytical capacity is a constant. This is recognised internationally regardless of the field of study (Kreber 2001).

> Critical thinking and self-direction in learning are two outcomes of higher-order learning that have been recognised as important goals of higher education at a time when rapid social, political and technological changes make one realise that the content or factual knowledge presently taught may not be sufficient, let alone useful, throughout one's lifetime (Kreber 2001, p.218).

A second reason for selecting a PBL approach is that PBL courses are geared towards the resolution of problems. Whilst behaviourists assume that once a learner has mastered a body of knowledge, he/she will automatically be able to apply it when required, proponents of PBL argue from the stance of "situated learning" that

[55] Term coined by Jean Paiget in the early 1900s.

knowledge is very context specific and that learners need to be trained to use their knowledge to resolve problems if this is what is expected of professionals in their field (O'Donnell 1999). Laurillard (1996) adds that the abstraction needs to be grounded in multiple contexts to be transferable and that learners need to additionally acquire skills to be able to identify situations in which the concept fits and situations in which it does not. Proponents of contextual, authentic or situated learning claim that only through acquiring knowledge in a situation that is authentic and meaningful to the learners can the learners acquire concepts which are then usable in new and different situations (Laurillard 1996; Jonassen 1998; O'Donnell 1999; Herrington et al. 2000; Riel 2000).

> In the situated cognition model of constructivist educational theory, instructional events are designed with a view to embedding the acquisition of concepts within some realistic and meaningful task. …Student involvement in these tasks gives students a more realistic picture of the components of expertise in a given domain, practice in higher order thinking skills, and the ability to apply new knowledge in a variety of problem-solving contexts, and in the manner of experts (O'Donnell 1999, p.217).

Learning through real world scenarios is also consistent with cognitive apprenticeship theory (Bonk & Cunningham 1998). This view of learning situates students as “legitimate peripheral participants” in an authentic community of practice and guides their learning as they internalize the standard cultural practices of their field or discipline and gradually take on a central role in the community (Bonk & Cunningham 1998). Taking direction from theories of cognitive apprenticeship, Stacey (2005, p.143) advises that ‘learning is not context-free but must be situated in a real-life context so the learner thinks as an expert in the field’. Polanco et al. (2001, p.4) claim that the failure to recognize the need to situate learning in domain specific problem scenarios, has often resulted in ‘a profession (being) learned when beginning to exercise it. This leaves the period of professional formation of little use for its purposes’. A cognitive apprenticeship approach fits well with the professional preparation agenda of FIT and the desire of FIT students themselves (demonstrated in future chapters) to acquire professional skills that will provide them with entry to their professional community of practice.

Accordingly two assignments were set based on real world problems and students were introduced to the PBL approach as a means of resolving these problems. Team facilitators explained the PBL process and showed a video[56] of Temasek Polytechnic students working through the process. The PBL approach was modelled based on these components of the approach summarized by Hallinger et al. (1999):

1. *An Introduction*. Introduces the problem to the student and explains why a PBL approach has been adopted.

2. *Problem*. The problem is defined and the problem scenario set up. Students analyse the problem based on their existing knowledge and identify ‘learning issues’ or questions that they are unable to answer without further research. The theory of situated learning asserts that what is learnt is linked to the context in which it is learned. If this view is accepted, it is rational to draw up a problem scenario which, as far as possible, resembles those that the learner will face in his/her professional life.

3. *Learning Objectives*. The knowledge and skills that the student is expected to acquire during the project are explicitly defined. There should be congruence

[56] http://pbl.tp.edu.sg/PBL-Resources/videos/PBL_process/pbl-process.htm

between the learning objectives of the course provider and 'learning issues' that students identify from their analysis of the problem.

4. *Resources*. Students are made aware of the resources at their disposal – usually online resources, mentors and textbooks.

5. *Product Specification*. The products that should be produced by the students and their due dates are listed. These products should be as realistic as possible.

6. *Guiding Questions*. Guiding questions are of two types. One type directs students to key concepts; the other type assists students in thinking through the problem. Guiding questions should be anticipated prior to launching the problem scenario and used to keep students productive and on-track during its implementation.

7. *Assessment*. The manner in which students participating in the PBL exercise will be assessed should be determined as part of the design. Proponents of cooperative learning suggest that '…the greatest achievement effects occur when there are group goals with individual accountability' (Locatis 1999, p.23). They base this on the premise that team work is improved if members of the team know that they will be awarded a group mark but that there must be checks to ensure that those with the most ability, motivation or conscientiousness do not do all the work.

4.3 Cultivating Teamwork

Both Sri Lankan and Australian employers placed high value on teamwork. The graduate attribute, *Work as part of a team in a productive and cooperative manner*, was ranked second in importance by Australian employers and sixth by Sri Lankan employers (refer to Section 3.2). The 2004 baseline study (refer to Chapter 3) suggested that FIT students may have been drawn to a workgroup style of small group work rather then true teamwork. This raised pedagogical concerns as well since I felt that this sort of approach to group work would tend to promote cooperative rather than collaborative learning.

4.3.1 Promoting Collaborative Learning

Cooperative Learning is an approach where the group divides tasks amongst themselves and then pools the final result (Topping 1998). In the workgroup style of small group work, the team leader takes responsibility for managing the assignment contributions of the individuals in the group. Anecdotal evidence suggests that this style of teamwork and a cooperative learning approach continued to be employed by some groups throughout the study as this response from participants in the 2005 focus groups illustrates.

> The three of us will work and the thing is when we get another assignment, we discuss and divide the parts. A disadvantage is say if a person is expert in the designing; person who designs always gets the designing part. So the person who writes won't get a chance to do designing. It's a disadvantage.
>
> (Participant, Focus Group 2005)

In contrast to this, Collaborative Learning (CL) takes place when a small group work together to solve a problem or produce a product. Dialog promotes learning through giving group members the opportunity to assimilate each other's knowledge and test their understanding of new concepts on each other (Topping 1998; O'Donnell 1999).

O'Donnell (1999, p.224) explains that with a cooperative approach to learning of this nature, students do not gain the benefits of working as a group since they do not have the opportunity to observe and learn from each other.

> Tasks are most truly and effectively peer learning tasks if they are structured for negotiated production of some cognitive product. Tasks that require division of labor eliminate the *guided stimulation* and *qualitative scaffolding* that undergird cognitive gains in peer learning (Salomon 1993). In joint production, students have the opportunity to observe and internalize modelled processes.

CL - sometimes termed peer-assisted learning (PAL) - can take the form of peer tutoring where a more expert peer explains the work to a classmate or it can take the form of group discussion (Topping 1998).

Students at FIT already participate in a form of peer tutoring – the *Kuppiya*. They consider *Kuppi* to be beneficial because their peers can understand their problems with the subject matter and because they can enter into a productive dialogue with them which they do not feel they can do with their lecturers.

> That's honestly because he's one of our friends and we will probe more and ask question since he's not a lecturer and because there is no distance.
>
> (Participant, Focus Group 2006)

> *Moderator*: Why do you study with friends?
>
> *Participant*: Because what we know we teach each other and what we don't know we can ask, we can enhance our knowledge when discuss.
>
> (Focus Group, 2006)

Although from these comments it was apparent that students in this study felt that the reason peer tutoring in the form of the *Kuppi* was so effective was simply because of the lack of power distance in the informal learning context, it is possible that a number of other factors noted in studies of CL/PAL elsewhere, might have been relevant. One of these factors is the level of cognitive congruence between tutors who are peers.

> The advantage of using students who are peers rather than non-peers in this process is that there is greater congruence between their cognitive structures (Collier 1980). This cognitive congruence renders tutors who are specifically peers better able to understand the difficulties encountered by their tutees and equips them to respond in a more adequate manner (Topping 1998, p.37).

O'Donnell (1999, p.37) also explains that 'peers can stimulate "lacunae" or gaps in understanding when they challenge each other's explanations leading to the sort of perturbation that underlies constructivist learning'.

It has been the experience of those attempting to foster CL, that it is sometimes difficult to convince students of the value of learning with and from each other. 'Some adults prefer direction in their learning process for reasons of efficiency, reliance on instructor expertise, or familiarity with traditional instructor-student roles' Schuttenberg & Tracy (cited in Slusarski 1994, p.71). Given the widespread acceptance of the *Kuppiya* it was not anticipated that this study would encounter such problems. Instead, the challenge was to design learning tasks that would encourage students to tutor and learn from each other in their formal subject area groups rather than merely in informal *Kuppiya* which only take place as exams approach.

I reasoned that, if it were possible to create a collaborative learning environment, it would not only help students to improve their teamwork skills but also promote deeper learning that would be transferable to other problem situations and, at the same time, through appropriate structuring of teams, improve social harmony between different ethnic groups in the university. Topping (1998, p.38) notes findings by Johnson and Johnson (1994) that the use of CL, 'resulted in more higher level reasoning, more frequent generation of new ideas and solutions (i.e. process gain), and greater transfer of what is learned within one situation to another (i.e. group-to-individual transfer) than did competitive or individualistic learning'. They also found that the use of CL promoted constructive relationships and positive attitudes among heterogeneous groups of students. Williams et al. and Ravenscroft et al. (cited in Koppenhaver & Shrader 2003) suggest that high-level thinking skills are developed because members are exposed to alternative problem-solving strategies from their peers.

The fundamental importance of dialog and social interaction in the construction of knowledge is a basic tenant of social constructivism (Stacey 2005). Social constructivists maintain that 'the learner must participate in cooperative learning in which the learner is exposed to alternative viewpoints that challenge initial understanding' Jonassen et al. (cited in Stacey 2005, p.146). CL experiences are also seen as being more motivational and emotionally rewarding. Ravenscroft et al. (cited in Koppenhaver and Shrader 2003, p.3) identify four theoretical models which purport to explain why this is so and why they feel collaborative learning is particularly relevant to tertiary students:

> *Motivational* theory indicates that people are goal-driven, and that cooperative settings enhance opportunities for both individual and collective goal attainment. *Social cohesion* theorists suggest that over time, group members develop positive affection for each other, thereby leading to satisfaction with the group. The *cognitive elaboration* view is that the interaction fostered in cooperative settings is intrinsically rewarding. And the *opportunity to practice* model states that talking improves learning more than passive listening.
>
> (Ravenscroft et al. cited in Koppenhaver & Shrader 2003, p. 3)

Given the collectivist nature of Sri Lankan culture and the proven popularity of the *Kuppiya* (both discussed in the previous chapter), there was every reason to anticipate that FIT students would find a PBL approach which fostered a collaborative learning environment to be a positive learning experience.

4.3.1.1 Structuring Teams to Promote Collaborative Learning

In structuring teams in the first year, reference was made to Wells (2002) who argued against allowing students to self-select team membership for a number of reasons. Firstly, he argues, this is not the way that teams are formed in the real world, and secondly, self-selected teams tend to be overly homogeneous. This latter point is, of course, particularly relevant to the social harmony agenda mentioned in the previous chapter. In order to promote social harmony, it would be better to promote greater interaction across ethnic lines, not less, a point clearly explained by a member of the FIT academic staff who also points out the need for a gender balance in teams.

> Now in Sri Lanka we have 3 main cultures – Sinhalese, Muslims and Tamils, these are the 3 nationalities we have. Now most of the Tamils they are coming from the war areas and this war has been there for more than 20 years now so that is one of the reasons we don't have proper relations with them. From the day that they were born, they are thinking in a different way, they are thinking that Muslim and Sinhalese people don't like them. To realize them the actual situation it takes about one year because that idea has been planted in their minds so little-by-little we have to do. Perhaps if we have common cultural variety shows and so on, they will have to get together and do things. So this is what I am thinking now, we can help them unite, we can develop some social relations between the 3 communities.
>
> Interviewer: What about the male-female barrier?

> Lecturer: Yes. In those days, in our time, we had a lot of mixed schools in Sri Lanka so that means we know who girls are so they are just like our normal friends, we don't have any sort of difference. But today in most of the schools, we have boys' schools and girls' schools separately so when they get here they want to stay separately.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Wells (2002, p.6) also quotes Robbins (2001) as saying that 'although some would argue that homogeneity in teams will more likely result in less team conflict and better team performance, diversity in teams presents better learning experiences'. Bruffee (cited in Stacey 2005) also suggests that in groups which are too homogeneous, there will not be the dissent necessary to provoke discussion and stimulate learning. Wells (2002) goes on to support team memberships of three to five with 'an odd number being best advised for working through conflicts' (Howard cited in Wells 2002, p.6). Bruffee (cited in Stacey 2005) recommends five due to concerns about group dynamics in smaller groups. Duch (2001, p.4) advises, 'When it is not possible to have a dedicated faculty tutor lead discussion, answer questions, and ensure equal participation from all students, it is best to limit the size of each group to four, at most five students'. Johnson et al. (cited in Duch 2001) recommend that students be assigned to groups of four in order to improve student accountability and ensure that each student gets his or her own "talk time".

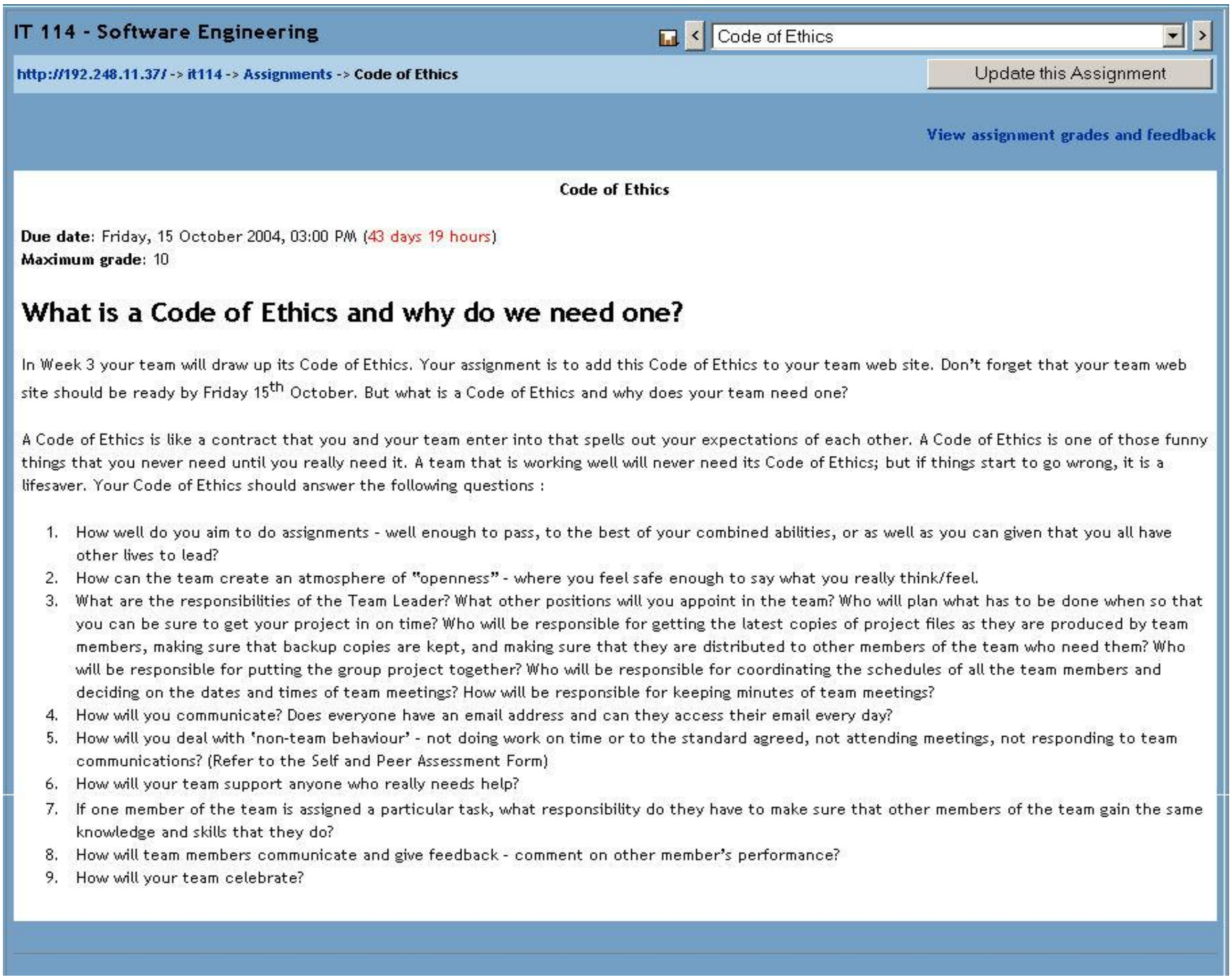
The course lecturer and I elected to have teams of five rather than four because this was a standard team size for FIT and many students elected to stay in the same team for both Software Engineering and their second year project subject. The course lecturer selected team membership to maximise diversity of gender, ethnicity and English-language ability. Apart from the social harmony aspect, it was hoped that putting students of mixed ethnicity together would force them to use English in team meetings, even in the absence of facilitators, as they otherwise had limited opportunities to practice spoken English.

In team meetings attended by facilitators, the use of English was made mandatory following the advice of a senior lecturer that students would only use English if forced to because of concerns about making mistakes.

> Maybe it is because of Sri Lankan culture also. In Sri Lankan culture if you make a mistake in your mother tongue it doesn't matter but if you make a mistake when you are speaking English, even a small mistake, people will laugh at you. So that is the problem. If you speak English you have to speak Queen's English. Otherwise keep your mouth shut.
>
> (Interview, Senior Lecturer 2005)

The leadership of the team was rotated between members with the first team leader being selected by the course lecturer and subsequent team leaders being elected by the group. It was anticipated that this would give an opportunity to more people to develop leadership skills and would also avoid putting too great a load on one person.

One of the first tasks that the team undertook was to negotiate a Code of Ethics (Fig. 4.1). The Code of Ethics was essentially an agreement or contract between team members covering how they would work together and how they would resolve conflicts should these arise. Although examples were provided, the wording was up to the team themselves and was to be published on their team web site (refer to Section 4.3.3).



IT 114 - Software Engineering

Code of Ethics

http://192.248.11.37/ -> it114 -> Assignments -> Code of Ethics

Update this Assignment

View assignment grades and feedback

Code of Ethics

Due date: Friday, 15 October 2004, 03:00 PM (43 days 19 hours)
Maximum grade: 10

What is a Code of Ethics and why do we need one?

In Week 3 your team will draw up its Code of Ethics. Your assignment is to add this Code of Ethics to your team web site. Don't forget that your team web site should be ready by Friday 15th October. But what is a Code of Ethics and why does your team need one?

A Code of Ethics is like a contract that you and your team enter into that spells out your expectations of each other. A Code of Ethics is one of those funny things that you never need until you really need it. A team that is working well will never need its Code of Ethics; but if things start to go wrong, it is a lifesaver. Your Code of Ethics should answer the following questions :

1. How well do you aim to do assignments - well enough to pass, to the best of your combined abilities, or as well as you can given that you all have other lives to lead?
2. How can the team create an atmosphere of "openness" - where you feel safe enough to say what you really think/feel.
3. What are the responsibilities of the Team Leader? What other positions will you appoint in the team? Who will plan what has to be done when so that you can be sure to get your project in on time? Who will be responsible for getting the latest copies of project files as they are produced by team members, making sure that backup copies are kept, and making sure that they are distributed to other members of the team who need them? Who will be responsible for putting the group project together? Who will be responsible for coordinating the schedules of all the team members and deciding on the dates and times of team meetings? How will be responsible for keeping minutes of team meetings?
4. How will you communicate? Does everyone have an email address and can they access their email every day?
5. How will you deal with 'non-team behaviour' - not doing work on time or to the standard agreed, not attending meetings, not responding to team communications? (Refer to the Self and Peer Assessment Form)
6. How will your team support anyone who really needs help?
7. If one member of the team is assigned a particular task, what responsibility do they have to make sure that other members of the team gain the same knowledge and skills that they do?
8. How will team members communicate and give feedback - comment on other member's performance?
9. How will your team celebrate?

Figure 4.1: Guidelines for preparation of Code of Ethics (Software Engineering 2005)

4.3.2 The need for facilitated teams

Based on my review of the learning environment in the 2004 baseline study, it would appear that what I was trying to achieve was a change in the learning culture. From cooperative to collaborative learning styles, from a workgroup to a teamwork approach to small group work, and from a passive learning style to an ability to learn independently.

There was, furthermore, an expectation of building higher order learning skills. Behaviourist modes of instruction, which have dominated the past learning experiences of FIT students, often fail to develop higher order learning skills (Bichelmeyer & Hsu 1999). But, it is these same higher order skills (application and synthesis) which students would be required to use in this course.

Finally, students were expected to work independently. The role of the lecturer in a PBL environment is one of a facilitator not a director (a "guide on the side" rather than the "sage on stage" (Stinson & Milter 1996)). Slusarski (1994) cites Caffarella (1993) in identifying four variables that determine readiness for self-direction in learning: level of technical skills, familiarity with the subject matter, sense of personal competence as learners, and the context of the learning event. Where learners feel that they have the technical skills required to navigate the learning environment, where the subject matter is something which is basically familiar and where the learning occurs in a familiar context, they are more likely to have the confidence to undertake the learning task with minimal guidance. FIT students, coming into the university environment with few computing skills (refer to Section 1.1.1) to study for a profession to which they have had limited exposure, in a language which is not their first language (refer to Section 1.1.1), certainly do not fit into this category.

In my assessment, all of this added up to trying to achieve a change in the learning culture. Accordingly, I decided that it would be necessary to provide students with hands-on support for team meetings wherever practicable. Lecturers were assigned to each team as facilitators and team meetings conducted both during weekly tutorial sessions and as often as required outside these tutorial sessions. Part of the time in tutorial sessions was also devoted to a program of exercises which concentrated on the four soft skills identified as priorities at the start of this chapter: teamwork, communication, self-directed learning and problem-solving. These exercises are discussed in more detail in the sections to follow and illustrated in the snapshot of the Moodle interface for each year (refer to Appendix D).[57]

The team facilitators and myself met each week to discuss problems, solutions and progress. Even though two of the lecturers acting as facilitators had done their undergraduate study overseas where small group work was the norm, the role was nonetheless a challenging one for them. At the same time, numerous studies have pointed to the role of the facilitator in PBL being pivotal (Aldred et al. 1997; Khoo 2003; McCracken 1999; Slusarski 1994; Taylor & Burgess 1995). Accordingly, in the second year, two of the facilitators were funded to attend a hands-on PBL Conference where they could learn more about the skills required.[58]

4.3.3 Teambuilding and teamwork skills building activities

Course activities began with a team building exercise which had team members taking on the roles of systems analyst, programmer/developer, and client to build a complex Lego model - an activity known as The Tinkertoy Game (Wells 2002). To consolidate their sense of team identity, each team was then required to use website building skills developed in their first year to build a website to introduce their team, present their Code of Ethics and showcase how each of the members would contribute to the life of the team based on their “preferred team role”. Prior to formation of the teams, students had been asked to complete an online personal profiling exercise[59] to identify their preferred team role[60] and the course lecturer then used this information in structuring teams. As students had already had experience in web site development in the first year of their course (and often through personal interest), it was anticipated that this exercise would give students an opportunity to establish team working relationships in a positive, non-threatening environment. The production of the website was made assessable both to recognise team building as a legitimate activity in a professional training course such as the one FIT was

[57] The Moodle snapshot illustrated in Appendix D does not include the interface created for 2006. The Moodle site built for 2006 crashed towards the end of the semester and university system administrators were unable to restore it from backups.

[58] PBL Conference 2005, at Temasek Polytechnic in Singapore, March 15-16, 2005.

[59] This was the “What sort of Team Player Are You?” online quiz from Queendom.com based on the Belbin, Margerison-McCann and MTR-I role typologies.

[60] Coach, Cheer Leader, Brainstormer, Coordinator, Go-getter, Networker, Peacemaker, Questioner, or Thinker.

providing and also to reward team effort. To help teams celebrate success, prizes were given for the top three sites.

To support teambuilding, student teams were invited to work through a number of exercises with their facilitators. This was done after considering other studies which concluded that students cannot be assumed to develop good teamwork skills simply by working in a group (McCracken & Waters, 1999). Figures 4.2 – 4.5 illustrate the relevant sections of the Moodle™ interface. Exercises included:

- A comprehension exercise based on the readings, Chapter 1 of Dr. Arthur R. Pell (1999): The Complete Idiot's Guide to Team Building, entitled “Why Teams” and Chapter 5 of Gary R Heerkens (2001): Project Management.
- An exercise where students are asked to role play a meeting having read “Running Effective Meetings” from the web site of MeetingWizard.org and Chapter 6 of Dr. Arthur R. Pell (1999): The Complete Idiot's Guide to Team Building entitled “Meetings. Time Wasters or Productivity Tool?”.
- An exercise where students are asked to react to a number of scenarios describing instances of team discord. The background readings for this exercise was Chapter 10 of Dr. Arthur R. Pell (1999): The Complete Idiot's Guide to Team Building entitled “Overcoming Team Discord”.
- A reflection exercise where students were asked to reflect on their experience of teamwork. This exercise was an assessable submission. As preparation they were asked to read background materials adapted, with permission, from the USQ Engineering Problem Solving I Course (ENG1101).

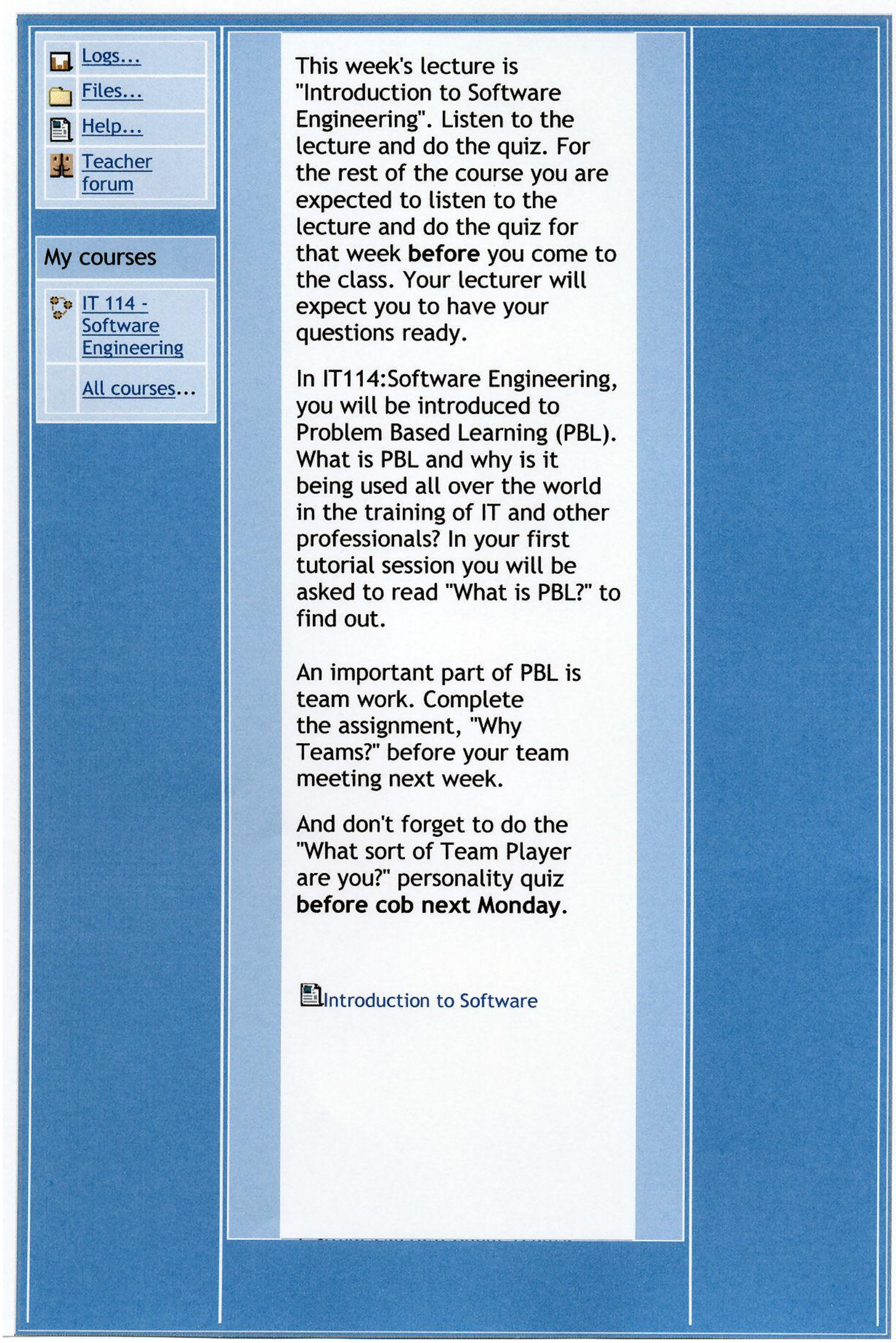


Figure 4.2: Moodle™ snapshot – Week 1 of course design

Students were asked to undertake the two readings on teamwork shown here and to determine their preferred role in a team environment. Their reflections on the latter were to form the basis of their individual profiles on their team website.

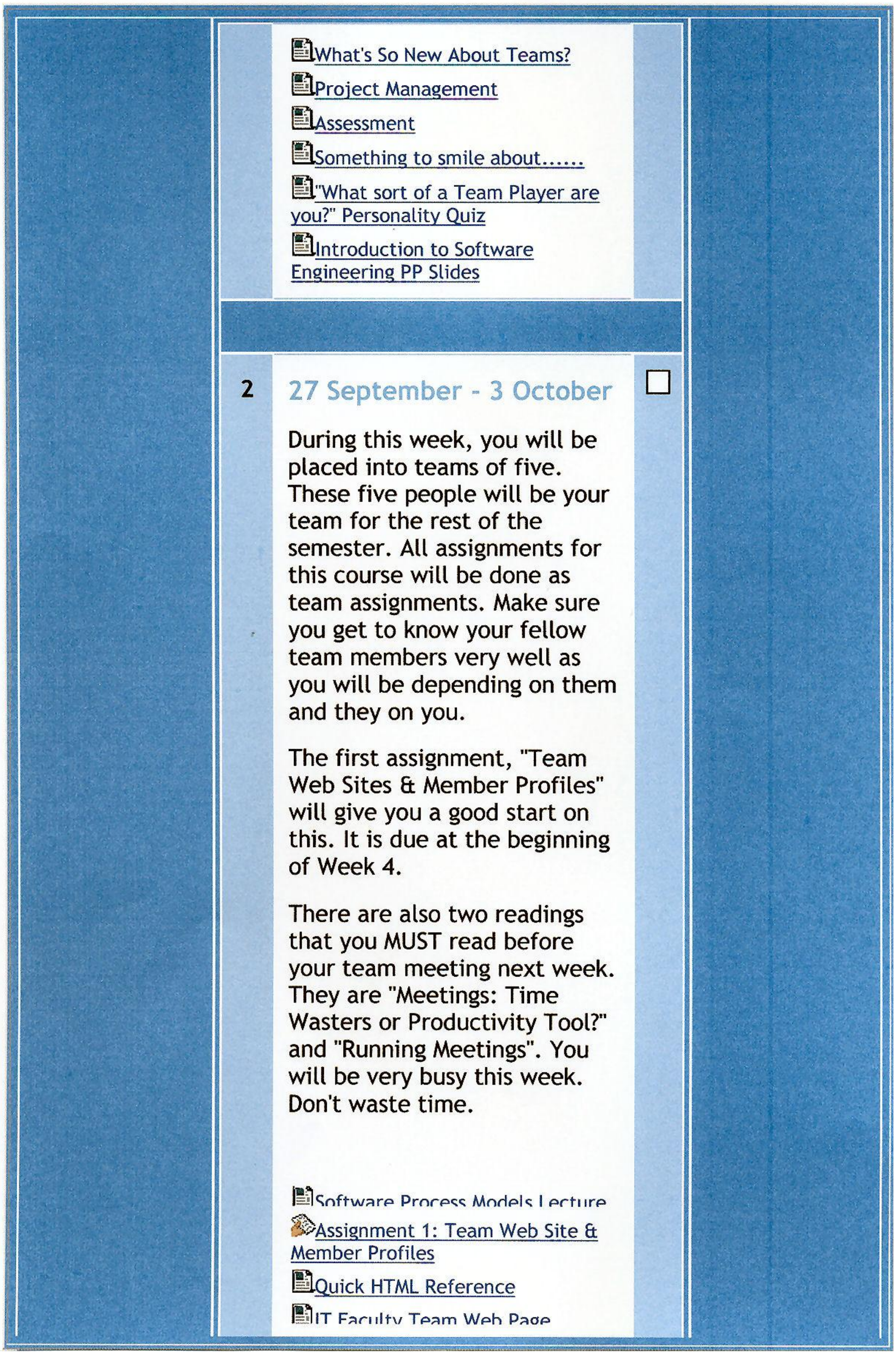


Figure 4.3: Moodle™ snapshot – Week 2 of course design

Since students were being asked to have their first meeting as a team, the tutorial session for the week focused on running effective meetings. In preparation for this, students were asked to read two papers on the topic as shown here.

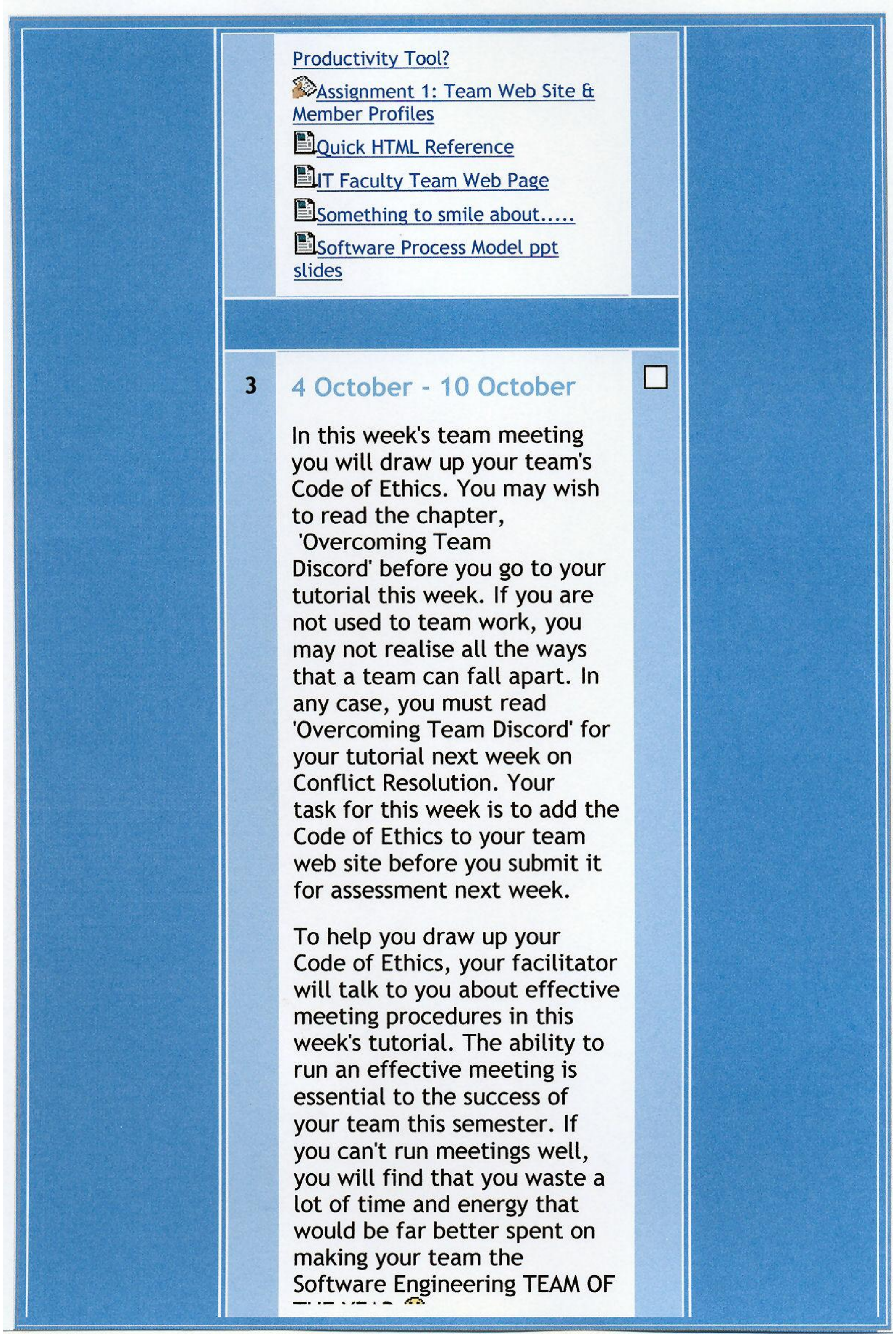


Figure 4.4: Moodle™ snapshot – Week 3 of course design

In week 3, students were preparing to draw up their Code of Ethics. Hence the tutorial topic concentrated on conflict within teams and how to resolve it. This snapshot shows how the connection between the task and the supporting tutorial were made explicit to students.

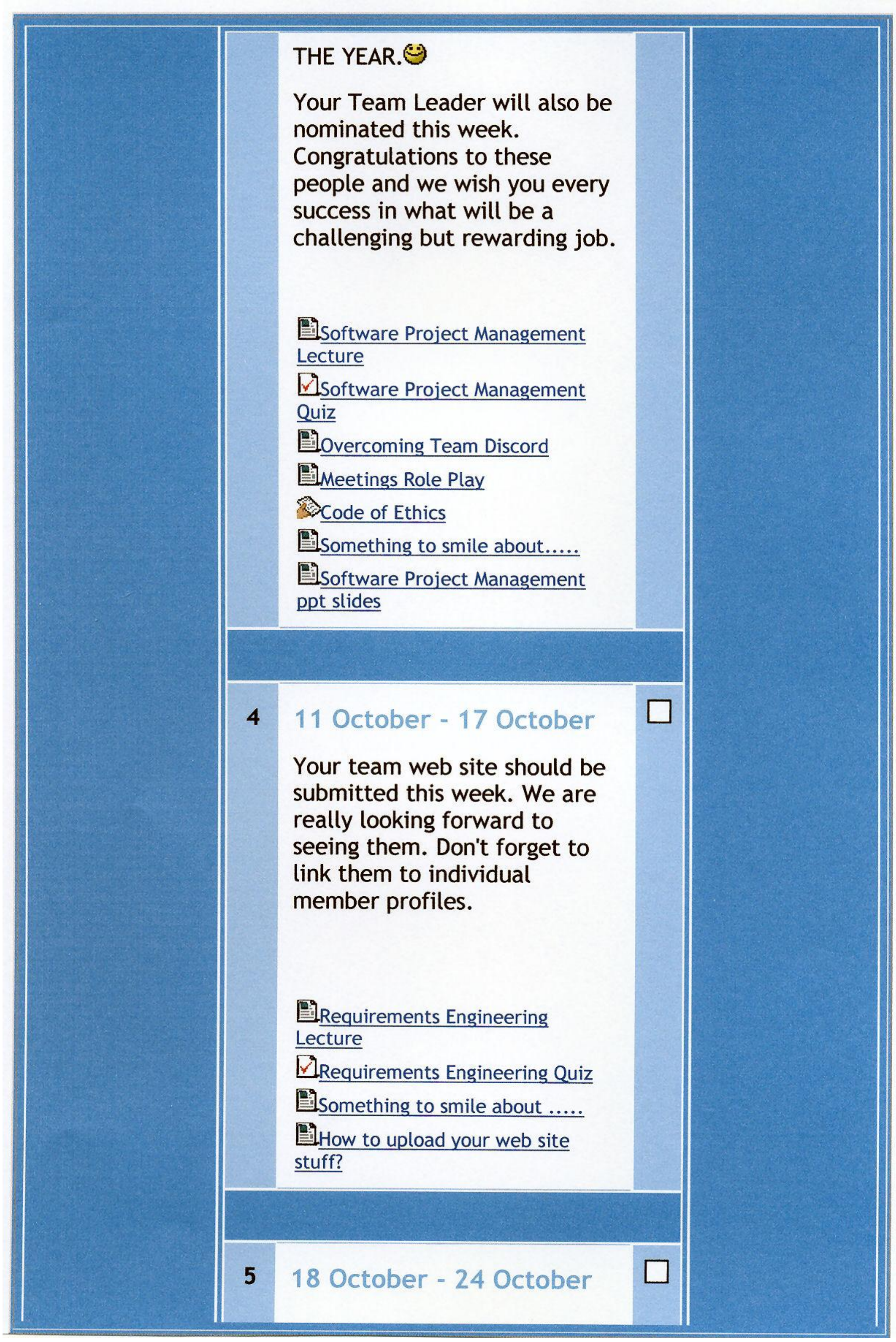


Figure 4.5: Moodle™ snapshot – Week 4 of course design

In week 4, the newly formed student teams uploaded their web sites on a publicly accessible site. This snapshot shows related instructions given to students.

The reflection by students on their experience of teamwork (not included in the Moodle™ CMS snapshots above as it was set in week 10 of the course) was seen as a critical component of the learning process. Proponents of experiential learning stress that reflection is an essential step in the process of internalising something which has been experienced (Jarvis et al. 2003). Unless the learner has the opportunity to reflect upon the experience and interpret it in light of their previous experience or knowledge, it will not become part of their internal knowledge constructs (Jarvis et al. 2003; Holzer & Andruet online) or will only result in single-loop learning or learning to adapt rather than double-loop learning (learning to change) (Hummelbrunner 2000). The intent was to provide students with an opportunity to experience good teamwork practices so that they reflect upon and internalize this good practice. This is consistent with the PBL approach which Richards & Bhattacharya (2000, p.5) note provides, 'a useful means for indirectly promoting reflective practice in terms of an activity-reflection cycle'.

4.3.4 Promoting Higher Level Learning

In designing problem scenarios, I looked for tasks that would focus the energy of students on higher order thinking skills such as evaluation, synthesis and application. To ensure this, Weiss (2003) advises designing a problem which requires students to extend their knowledge base and skills, which is ill-structured, and which is authentic as it relates to students' future plans and expected careers. Accordingly, in designing PBL tasks for this first course, I looked for relatively complex tasks that were closely tied to industry practice and which built on their previous knowledge and experience. This had the advantage of answering student criticisms that they were taught only the theory of what would one day be demanded of them in practice. As one of them very graphically put it,

> It's like this, for an example, if you learn to swim outside the swimming pool, you can say "You have to do like this and you have to put your hand like this". Nothing practical. Until and unless you get inside the pool you won't be able to swim. So what ever you study outside the pool is worthless ……
>
> (Participant, Baseline Focus Group 2004)

Accordingly the following assignments were set (illustrated in Figures 4.6 – 4.11) :

1. *Assignment 2*. Students were asked to present a case (in a group presentation) for using a particular Software Process Model[61] to develop a given software application. Each team was given a description of a particular case study describing a client and their software needs (there were five different case studies in all allocated randomly to teams) (Fig. 4.6). Teams were asked to select an appropriate software process model to be used to develop the software and to defend their selection.

   Given students' lack of exposure to the higher order learning skills required to complete this assignment, it was thought best to scaffold the assignment. The assignment was set in stages with students firstly asked to answer a series of questions that might, in a true PBL context, have been generated as learning issues.[62] Using these examples, they were asked to brainstorm additional learning issues for themselves. They were then asked to apply their

[61] A Software Process Model is a methodology for developing complex software systems.
[62] As described in Section 4.2 above, learning issues are questions that students are unable to answer without further research.

knowledge to generating a solution to the problem. Facilitators attended every team meeting held in preparation for this first assignment.

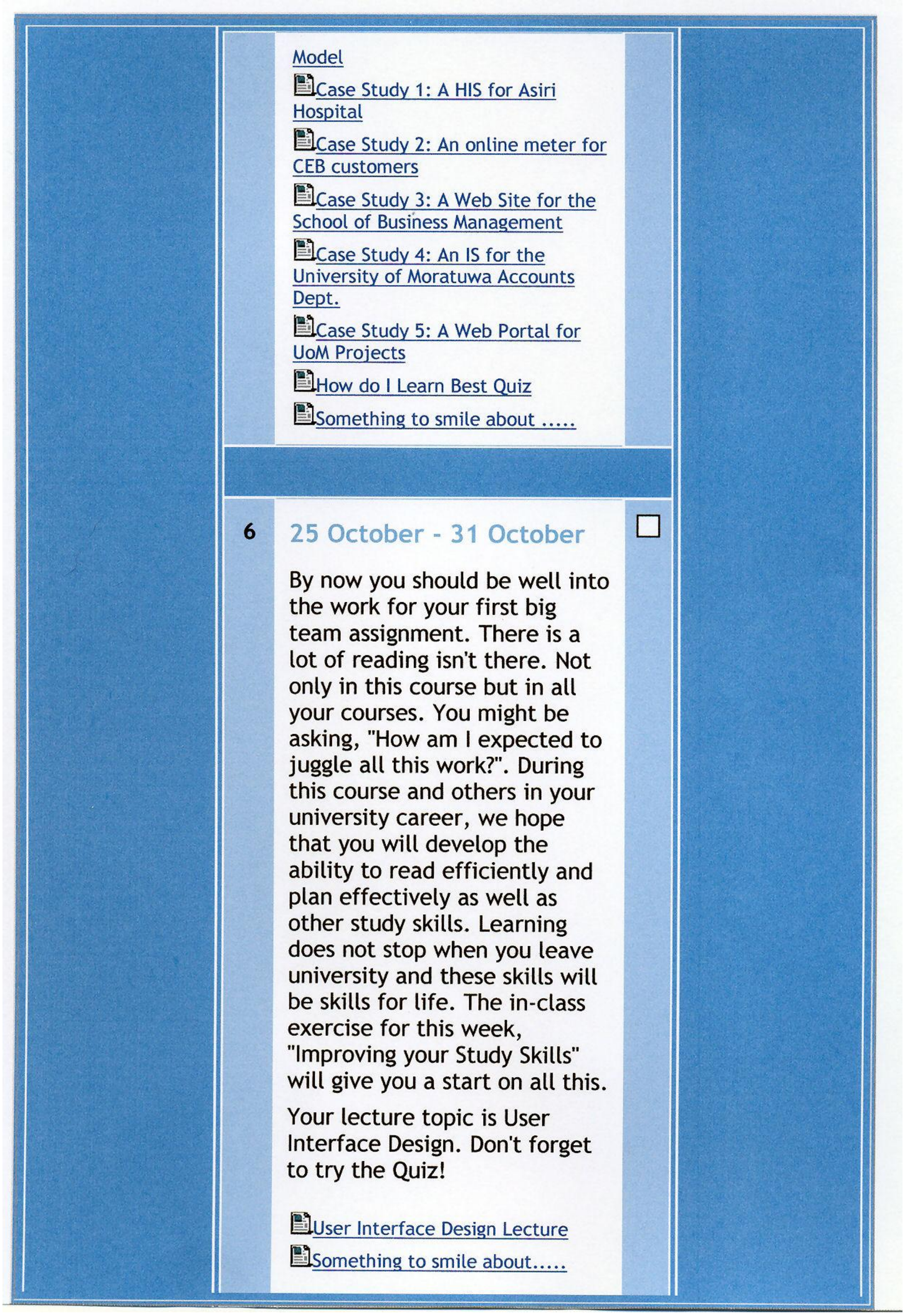


Figure 4.6: Moodle™ snapshot – Week 5-6 of course design

Student teams were randomly assigned one of the five case studies shown here as the basis for Assignment 2.

2. *Assignment 3*. In this assignment (illustrated in Figures 4.7 – 4.11 below), teams were asked to create a Software Requirements Specification (SRS)[63] for an actual Colombo-based training institute known as the Academy of Design. This assignment was structured to follow industry practice in that students were provided with a general description of the required system written by the client (the tender document) and were then invited to meet with the client to ask any questions they might have in an open meeting with other bidders for the tender (the Bidders' Conference) and were finally invited to write and present the SRS. The requirement to generate questions for the Bidders' Conference effectively served as a prompt to generate learning issues or at least those that could be answered by the client. To further assist them, students were invited to participate in an online chat session with the client while they were preparing the assignment. Because this was done through the Moodle™ CMS, the chat session transcript was permanently available for their reference. It was hoped that this would help those who found it difficult to follow the rapid exchange of English in the chat session.

[63] An SRS is a document which sets out in very specific terms the functionality that the software to be developed will deliver. The SRS often forms the basis of the contract between the client and the software developer.

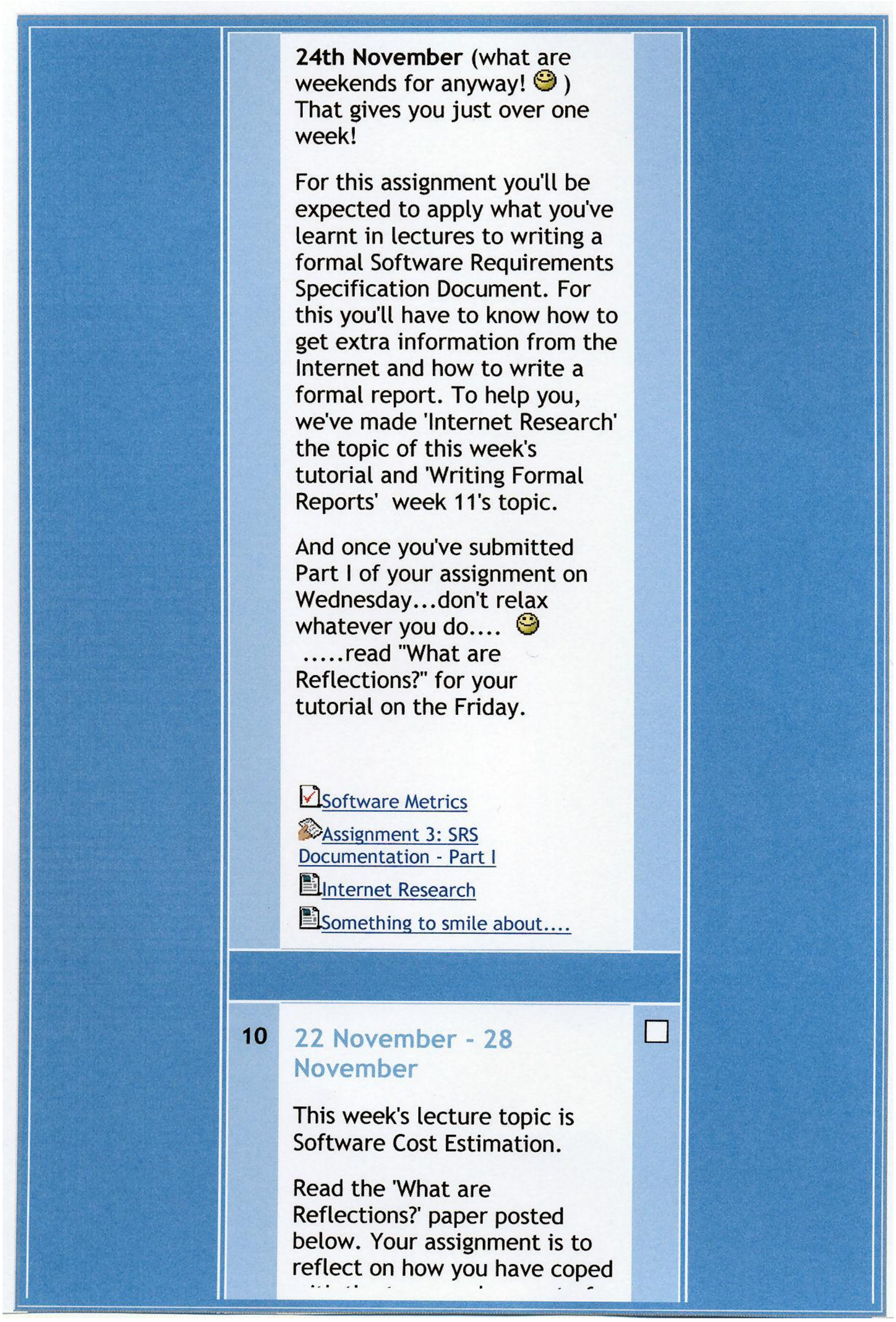


Figure 4.7: Moodle™ snapshot – Weeks 9-10 of course design

In week 9, students were given the first part of Assignment 3 (illustrated here) which required them to generate the types of questions that would normally be asked of a prospective client at a Bidder's Conference. As shown above, two tutorials sessions were organised to help them.

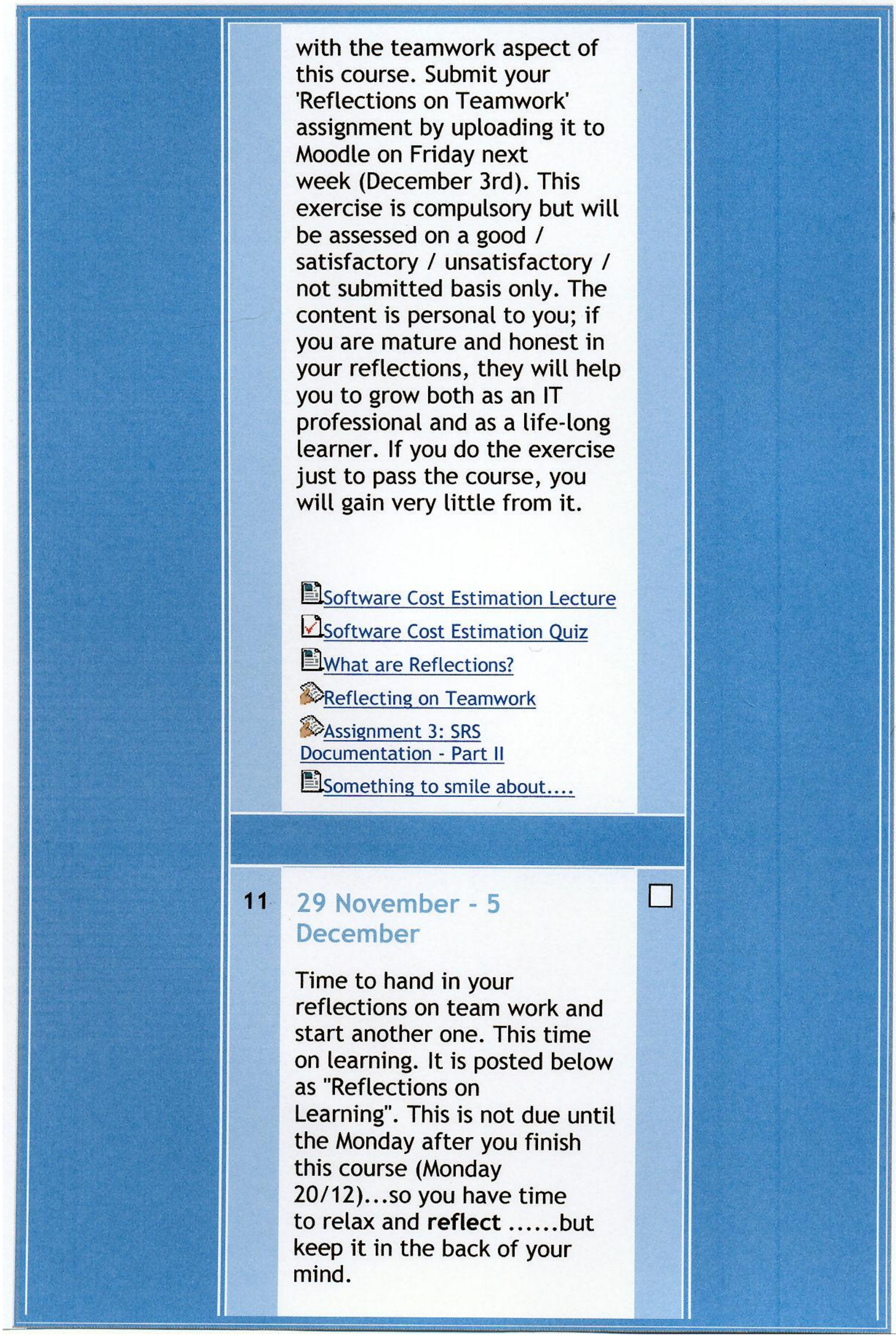


Figure 4.8: Moodle™ snapshot – Weeks 10-11 of course design

In week 10 after visiting the client, students were given the final part of Assignment 3 (illustrated above) which required them to prepare the SRS based on information received from the client. As shown in the snapshot, they were also asked to reflect on their experience of teamwork.

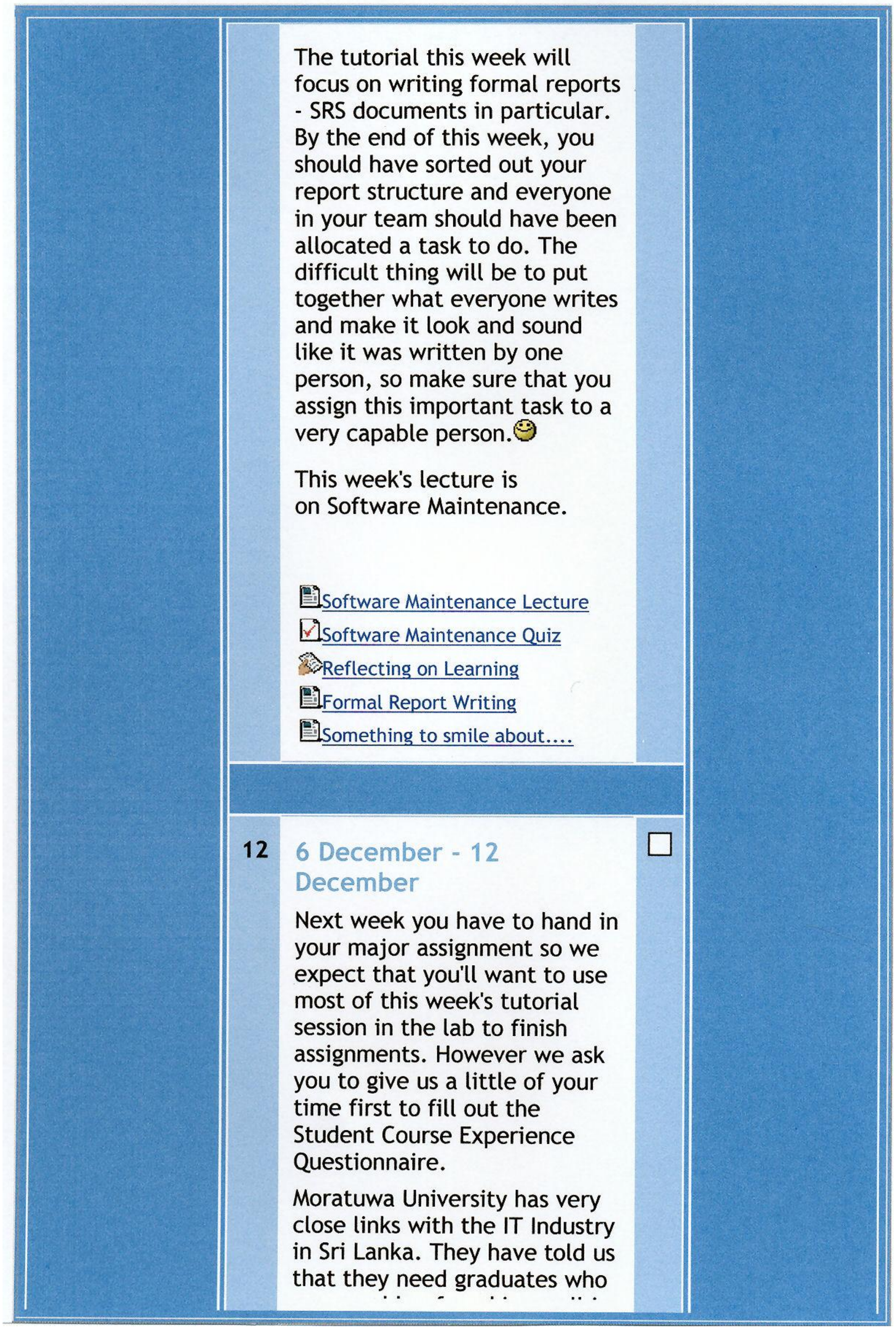


Figure 4.9: Moodle™ shapshot – Weeks 11-12 of course design

The tutorial for week 11 (illustrated here) focused on formal report writing skills which would be necessary in preparing the SRS for Assignment 3.

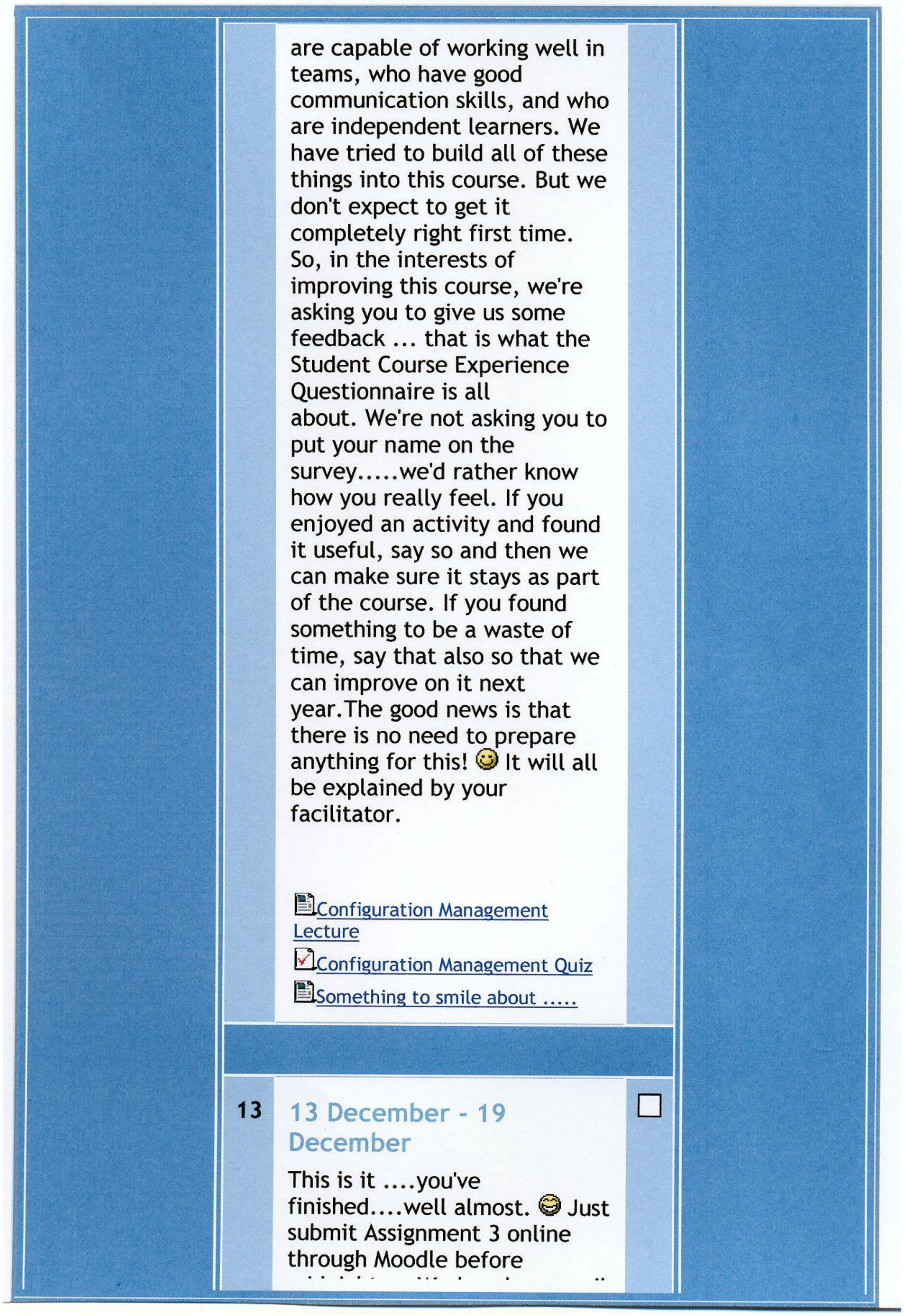


Figure 4.10: Moodle™ snapshot – Weeks 12-13 of course design

In week 13, as shown in this snapshot, students were asked to submit Assignment 3 and give their comments on the course in the Course Experience Questionnaire.

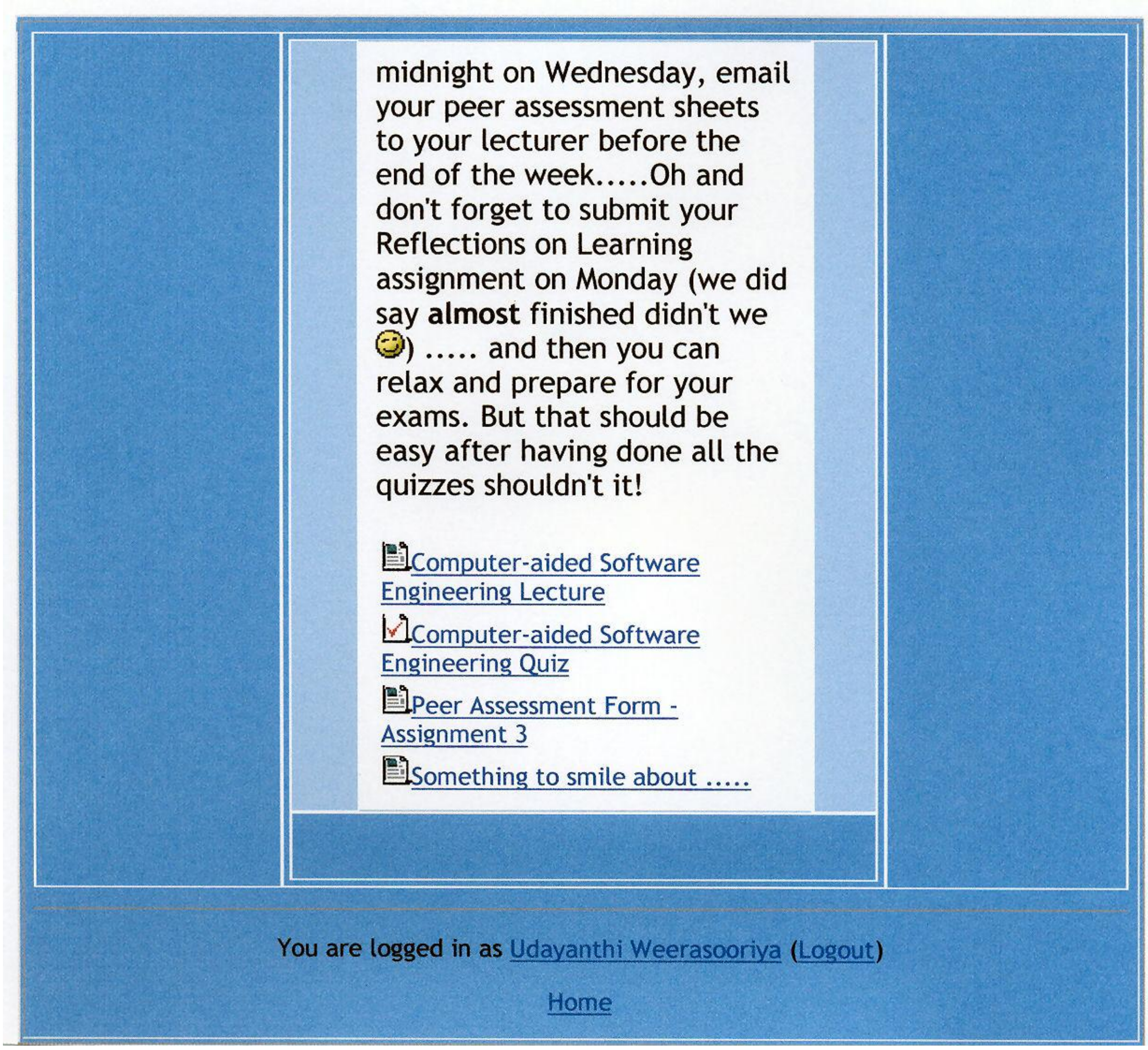


Figure 4.11: Moodle™ snapshots – Week 13 of course design

This snapshot of the interface for week 13 shows students being reminded about the availability of online quizzes for each topic and their requirement to complete peer assessment forms for Assignment 3 as well as a reflection on learning.

Both assignments required students to apply their knowledge rather than merely copying the answer from a secondary source such as the Internet - a commonly used strategy for FIT students[64] and one which is typical of students learning in a second language environment where they lack confidence in their own written expression (Cammish 1997). It was also hoped that if assignments were sufficiently complex, it would be difficult for students to merely divide the assignment into parts to be completed in isolation – as mentioned previously, this is a cooperative learning approach generally favoured by FIT student teams.

4.3.5 Building Communication and English Skills

The 2004 baseline study indicated that a paucity of English language skills was an issue for FIT students and Chapter 3 went on to explain the background to this. Interestingly, Sri Lankan employers also identified the *Ability to comprehend oral and written instructions* as an attribute of particular significance[65] to them outside the

[64] Feedback from focus groups.
[65] Ranked 14th out of 40.

attributes included in the Australian study, suggesting a perceived lack of general communication skills in Sri Lankan graduates.

Accordingly, a presentation component was built into each assignment. In Assignment 2, students were asked when making their presentation, to imagine that they were speaking to an audience which would include their boss (the Chief Technical Officer of their company) and the client (a non-technical person). In the given scenario, their team had been given a very short time in the meeting agenda (10 minutes) and their boss had told them to use it to convince the client that their Software Process Model was the best possible strategy for developing the client's product. In Assignment 3, student teams had to present the highlights of their SRS to the client to help their company win the contract to build the system.

To assist the students to prepare for these presentations, their facilitators worked through a number of exercises with them during the semester (refer Fig. 4.12). These included:

- "Making Good Oral Presentations" – an exercise where they were given some online readings in presentation skills and then asked to view and comment on a video of a "good presentation" and a "bad presentation".[66]
- Practice sessions of their own presentations with feedback from staff and fellow students.

A tutorial on presentation skills (illustrated here) was organised to assist students prior to having to make their first team presentation.

A facilitated tutorial session was devoted to each of these sessions. Students also had the opportunity to practice speaking in English in the weekly facilitated tutorial sessions where they were required to use English, in team meetings where the mixed composition of teams discouraged communication in *swabhasha*,[67] and in lectures where any interaction with the lecturer was in English. To encourage communication in lectures and to promote opportunities for CL, the lecturer invited students to sit in team groups and to ask questions about the lecture as a team. Lecture notes were made available online through the Moodle™ CMS at the beginning of the semester both as PowerPoint presentations and as an Articulate Presenter™ slide show.[68] Students were told that they were expected to have read or watched the lecture prior to coming to class.

Responding to the limited English language proficiency of many students, lecture notes were provided both in hardcopy format and online, with and without voiceovers, and with associated quizzes. Baker (2001, p.197) notes that, 'Listening to a new language demands high concentration, it is tiring, with a constant pressure to think about the form of the language and less time to think about curriculum content'. It was anticipated that reducing the pressure for students to take lecture notes, would allow them more time to concentrate on understanding the language and content of the lecture.

---

[66] University of Central England web site, http://www.cie.uce.ac.uk/essential/present/index.html

[67] Literally "mother tongue" – in the case of these students, Sinhala or Tamil.

[68] We used Articulate Presenter™ to record the lecture as it would be presented in class and to run it as an automated slideshow. This program allowed us to record a voiceover for each bullet point on each PowerPoint slide and then converted the whole slideshow to a Flash animation to be played back in a web browser.

Figure 4.12: Moodle™ snapshots - Weeks 7-8 of course design

4.3.6 Building self-directed learning ability

A *Willingness to embrace change and to engage in incremental improvement to keep up with the rapid change in technology* and *Willingness to participate in continued learning and intellectual development and develop critical, reflective and creative* *thinking* were two of the graduate attributes / soft skills particularly endorsed by Sri Lankan employers, ranking 9th and 10th respectively in the employer survey (described in the previous chapter). This reflects the rapidly changing nature of the ICT field in that an ICT professional needs to continuously undertake professional development in order to keep abreast with changes in the field.

While some opportunities for the ‘continued learning’ and ‘incremental improvement’ sought by employers above would naturally be provided by the employer themselves, much of it could be expected to take place through independent self-study. In the IT field, much of one’s professional development involves self-study of tools, languages and applications as and when it is necessary to master them. It is not always possible to find a formal course to follow and often one has to identify available learning resources and use them in self-directed study. Thus, one of the skills that FIT students need to develop is that of the independent learner. Comments made by students in the baseline study indicating that they felt in need of more support and direction in their learning (Section 3.4.4) suggested that students would benefit from assistance in developing self-study skills.

While UNESCO claims that motivating people to engage in self-directed learning is one of the primary goals of education,

> The world in which we live is constantly changing. UNESCO considers that education should last the whole life of an individual; lead to the continual acquisition and update of knowledge, skills, and attitudes; be self-fulfilling; acknowledge all available educational influences; and be motivating for people to engage in self-directed learning (Candy et al cited in McGill 2003, p.294)

work done in the 80’s in the field of adult learning suggested that, in fact, ‘only a third or a quarter of learners are self-directing individuals, the majority being people who do what they are supposed to do’ (Rogers cited in Stacey 2005, p.148) and advises that teachers need to build student capacity for autonomous learning gradually through providing considerable direct support at the start of a course and then encouraging self-directed learning as soon as possible with the help of CL groups.

Ellsworth (cited in Slusarski 1994) found that confidence in ones’ ability to learn by oneself is an essential prerequisite to engaging in self-directed learning. Slusarski (1994) goes on to suggest that one technique for building confidence is to expose the learners to the concept of learning styles. By discussing different learning styles with learners or having them complete a learning style inventory, mismatches between their learning approach and instructional approaches used can be examined. Often, when learners know their preferred learning style, they will have more control over the learning experience (Slusarski 1994).

Bearing these findings in mind, the following exercises were embedded into the tutorial program (Figures 4.6 – 4.12),

- “How do I learn best?” – exercise that required them to complete the Vark Questionnaire online (www.vark-learn.com) to establish their preferred learning modality - Visual or Aural or Read/write or Kinesthetic, and discuss with their tutors what this meant about how they should study.
- “Improving your Study Skills” – comprehension exercise based on online readings about 1) Effective reading techniques, 2) How to take good notes in lectures and 3) How to study.

- Mind Maps – they were asked to mind map what they had covered in the course so far.
- "Internet Research"[69] – they were asked to analyse three web sites that they intended to use for their assignment against the UCE (University of Central England) Birmingham P.R.O.M.P.T. test (stands for Presentation, Relevance, Objectivity, Method, Provenance, Timeliness) to encourage them to critically assess the value of any information found on the Internet.
- "Reflecting on Learning" – they were asked to write about what was the most valuable learning experience they had had in the course and what was the least valuable. This was a submittable assignment.

Again, course lecturers felt that the reflection paper was a critical learning exercise helping students to think about their experiences during the course and internalise learning strategies which had been of value to them.

4.3.7 Assessment

All formative assessment in this course was done on a team basis. Examinations were sat and graded on an individual basis. As the end-of-semester examination (summative assessment) effectively measured content knowledge, formative assessment marks were allocated to reflect a focus on professional skills and higher-order learning skills. The marks breakdown has been given earlier in Table 4.1. The marking guides for the three assignments are given in Table 4.3 below. For instance, 75% of marks allocated to Assignment 3 (the SRS specification) required application or synthesis of knowledge. Students were required to understand the concepts of functional and non-functional requirements and generate a list of requirements for the task (Table 4.3) whilst 60% of marks allocated to Assignment 2 (about software process models) assessed soft skills – primarily oral and written communication skills.

Table 4.3: Marking Rubric for Assignments

ASSIGNMENT ONE (5% of course grade)	
Profile for each individual team member listed on Moodle	3
Team Web Site	
- Team name and Logo	1
- Discussion of individual preferred Team Roles and what will be done to make the team work	2
- Code of Ethics	2
- Site design	2
TOTAL	**10**
ASSIGNMENT TWO (10% of course grade)	
Oral Communication/Presentation Skills	5
Appropriateness of presentation material for audience	5
Quality and relevance of argument presented	20
Professional appearance of PowerPoint presentation	10
Professional appearance of presenter	5
Response to questions from the audience	5
TOTAL	**50**

[69] This was particularly relevant for FIT students whose main source of information was the Internet, as books in the university and faculty libraries were limited.

ASSIGNMENT THREE (20% of course grade)	
Formatting, presentation, wording, use of headings	10
Description of the problem	5
Clearly specified functional requirements	15
Clearly specified interface requirements	15
Clearly specified non-functional attributes	5
Evidence of synthesis and application of SE theory studied throughout the cours	15
Innovative Solution / Approach	10
Supporting appendices/sections	10
Relevance of questions asked of client	10
TOTAL	**100**

Marks were also allocated for Assignment 1 (5% of course grade: Table 4.3) which required students to construct a team web site. Although this was clearly a team building assignment with little relevance to the technical aspects of Software Engineering, it was thought important to reinforce the value of soft skills for Software Engineering professionals. In a course of this nature there is always the danger of giving out conflicting signals. Cohen (2002) refers to a 'seminal article in the literature of compensation management entitled, "On the folly of expecting A while rewarding B," by former Academy of Management president Steve Kerr' (Cohen 2002, p.15). Kerr was speaking from a business management perspective and making the point that a company cannot hope to direct work behaviours in one direction while the compensation system directs them in another direction. The point is equally valid for universities. There is no use spending time on developing soft skills in a course if the students know they will only be evaluated on their technical/content knowledge. Consequently, the message they receive is that soft skills are really not all that important.

4.3.7.1 Peer Assessment

Judging from student comments during the baseline study, individual contributions to teamwork were highly variable with the team leader in many cases bearing the brunt of the load. This phenomenon, known as "social loafing" or "freeloading" has been frequently noted in the literature as a demotivating aspect of teamwork and has serious implications for the development of teamwork skills and opportunities for CL (Koppenhaver & Shrader 2003; Havard et al. 2005). Social loafing (Koppenhaver & Shrader 2003; Havard et al. 2005) is the tendency of some students to make minimal inputs to the group product knowing that others in the team will somehow complete the work on their behalf.

In other settings, peer assessment has been used as a deterrent against social loafing by helping to identify differences in individual contributions to team projects through a marking scheme which recognises individual accountability as well as group responsibility (Allen et al. 1989; Gatfield 1999; Koppenhaver & Shrader 2003; Havard et al. 2005). It can also be used as a learning method allowing students to provide feedback to their peers on their academic performance (Roberts 2006; Wen & Tsai 2006) but it is the former usage of peer assessment that was of interest in this study given its potential to increase levels of participation among team members.

Findings from studies using peer assessment for this purpose are mixed. Gatfield (1999), working with undergraduate students at Griffith University, found general support for peer assessment with international students (mainly Asian) expressing even higher levels of satisfaction with the peer mark award process than their Australian peers. Havard et al. (2005) similarly found that the use of an individual peer grade for a group project increased students' preference for working in groups while Koppenhaver & Shrader (2003) found that a high weighting placed on peer evaluations in calculating course grades improved the performance of their student teams. However, Papinczak et al. (2007, p.181), working in a PBL environment in the School of Medicine at the University of Queensland, found their students to be uncomfortable with rating their peers with both students and tutors having 'serious reservations about the negative impact of peer assessment on the integrity and interactive functioning of the PBL tutorial group'. They conclude, 'It may be that learning environments that are highly dependent on effective collaboration are not well suited to peer assessment' (Papinczak et al. 2007, p.182). At the same time, Koppenhaver & Shrader (2003, p.6) cite studies by Ravenscroft et al. (1995) and Bacon et al. (1999) which 'extend earlier research results to show that variations in team grade incentives including peer evaluation have little effect on individual test performance. While peer evaluation sensitizes a team member to the benefits of his or her contribution to the team's effort … peer evaluation is negatively related to highly rated team experiences because it inhibits the resolution of unproductive conflict during the semester. Students use peer evaluation at the end of the semester to anonymously hold social loafers accountable instead of resolving conflicts as they occur'.

On balance, considering the extent and impact of the "freeloader" or "social loafing" problem reported in the baseline study, it was felt that there would be value in adopting a peer assessment scheme as an incentive to team participation. Accordingly, an instrument from the Problem Solving I course conducted at the Faculty of Engineering and Surveying at USQ[70] was adapted for use in this study (included in Appendix E). Using this instrument, students were asked to rate themselves and their team mates on a scale of 0 (not at all) to 6 (always) to reflect the extent to which they embraced their team responsibilities including attending and contributing to team meetings, completing assigned tasks and adhering to the team code of conduct. These ratings were statistically combined[71] and used to calculate an individual grade to be used in combination with the team mark.

It was recognised that initially it would be important to sell the concept of peer assessment to FIT students. Given their collectivist culture and the observed importance of group study outside formal learning settings, a response similar to that reported in the Papinczak, Young & Groves (2007) study would not be unexpected. Following discussions with facilitators, three points emerged which we felt needed to be stressed to students. These were:

[70] Access to instruments used in the PBL program at the Faculty of Engineering and Surveying at USQ was kindly given by Dr. Lynn Brodie and Associate Professor Mark Porter who lead the program.

[71] Team marks were moderated as follows:

1. An individual's cumulative peer assessment rating (adding up that given by all members of the team) is calculated as a percentage of the highest possible rating.
2. The individual's peer assessment rating is then converted to a standard deviation score (ie. how many standard deviations his/her rating is above or below that of the rest of the team).
3. An acceptable mark range is identified. For the first assignment this was +/- 15. If an individual performed 3 standard deviations above the mean rating for their team, their individual grade would be the team mark plus 15 (with a maximum of 100%). Similarly if they performed very poorly, their individual grade would be 15 marks less than the team mark (with a minimum of 0%). The acceptable mark range was identified from empirical studies of the previous year's Software Engineering class.

1) Freeloading, if continued on into the professional arena, would be detrimental both to the individuals concerned and the reputation of the university;

2) Students who did not participate in group assignments would miss the opportunity to learn practical skills; and

3) Students have a responsibility to their team mates to ensure that they develop the teamwork skills desirable to industry employers and should exercise this responsibility either by counselling their friends or by using peer assessment ratings as a mechanism to encourage them into better habits.

4.4 Summary

This chapter has endeavoured to describe the propositional framework upon which the instruction design embodied in this study rests. This is essential if the study is to contribute to the body of educational knowledge. It was established that the primary basis of the design was constructivism in that the emphasis was on providing the learner with opportunities to construct knowledge by interacting with the problem situation, the resources at his/her disposal and his/her peers. The design sought to capitalize on the collectivist culture of the student body and the tradition of the *Kuppiya* to build CL opportunities through teamwork with peer assessment employed as a mechanism to address the issue of social loafing identified in the baseline study.

It is contended that being presented with problems to resolve is an essential component of professional training for Software Engineers. Reference is made to the theory of situated learning which stipulates that knowledge is very context specific and that learners need to be trained to use their knowledge to resolve problems as that is what is expected of professionals in their field. Accordingly a PBL approach was deemed to be an appropriate pedagogical basis for the course design. In line with employer and faculty expectations, the course design also targeted teamwork, communication and independent learning skills and the development of higher order learning skills. Given this emphasis on promoting higher order learning skills and soft skills, a significant level of scaffolding was thought to be required and the chapter describes the learning exercises including assignments, presentations, tutorial discussions, exercises and role plays that were used to provide this. Care was taken to match assessment processes to the educational goals of the design.

The next chapter describes the impact of the designed intervention, drawing on information from triangulated data sources to avoid bias. Based on this analysis, changes were made to the design in 2005, and the next chapter concludes with a rationale for changes introduced in 2006.

CHAPTER 5

Analysis of Phase I (2005) and Implications for Design of Phase 2 (2006)

In 2005, the course design derived from the analysis of the baseline study, the literature review and the employer survey undertaken in 2004 and described in detail in the previous chapter, was implemented for the first time.

The priority in the course design was to prepare a professional development course for prospective Software Engineers. As Software Engineers are primarily problem solvers, a PBL approach putting students in a situation where they interact with real world problems and with their peers was a logical choice. Because of their importance to employers, the development of soft skills such as communication, teamwork and independent learning skills were emphasised. Once again, the development of such skills fitted well within a PBL framework.

However, most studies using PBL approaches have been conducted in western contexts, particularly in the medical and engineering fields. The literature review revealed only one documented case of a PBL approach being used in the tertiary sector in a non-western context: Medical Faculty of the University of Colombo, Sri Lanka (Khoo 2003) - where the implementation had met with only limited success. Whilst it was hypothesised that building on the collectivist culture of the student body to create opportunities for collaborative learning through teamwork was likely to be a successful strategy, it could not be expected that this first iteration of implementing the design would be an unqualified success. Too little was understood about the context and how it was likely to impact on the design. This was, in fact, one of the primary reasons why a design-based research methodology encompassing multiple iterations of design, implementation and re-design, had been selected for the study.

Careful monitoring and documentation of the outcomes of the implementation were a critical component of this second year of the study. Data drawn from student opinion surveys, classroom observation, student results and reflections and interviews with academic staff in 2005 provided triangulation of data sources to avoid bias. To gauge student opinion, 24 students were invited to participate in three focus groups where they had the opportunity to comment on their learning experiences during the semester. All accepted the invitation. Focus group interview transcripts were prepared by the moderators in electronic format omitting the names of participants. Student reflections on learning and on teamwork, submitted electronically during the course, were also collected. In analysing and reflecting on student comments, reference was made to notes taken from informal weekly sessions with course facilitators and the transcript of the formal interview with facilitators conducted at the end of the semester. In the final lecture of the semester, all students were invited to complete a course experience feedback questionnaire. This was similar to that completed by the students in the 2004 baseline study to facilitate comparison of findings. In 2005, the response rate to the questionnaire was 67%. A chi-square test was used to compare results from the 2004 course experience feedback questionnaire and that completed by students in 2005. The five point Likert scale used in the questionnaire was first consolidated to a three point scale to avoid small values in the expected values contingency table.[72]

All instruments were designed to focus on the first research question for this study, namely:

> How can a problem-based learning approach be implemented effectively in FIT to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills?

The findings were analysed both from the perspective of identifying the elements of the course design which had contributed effectively to student learning and the development of critical soft skills, but also with the purpose of identifying elements of a theoretical framework which could explain the results. This was consistent with the second research question:

> How can the lessons learnt from the experience be used to derive a theoretical framework which could be applied beyond the limited context of the study?

5.1 *Impact of the Course Design – Analysis of the Data*

Following the constant comparative method described in Chapter 2, student responses were coded into emerging themes or categories. Categories that derived from only one or two data sources (particularly where the students were in the same team) were discarded. Many categories quickly became saturated[73] indicating substantial consensus in student perceptions. From student comments, it became apparent that very few of the themes or categories were independent of each other with many influences mutually reinforcing each other to add up to either a positive or negative experience of the course. Through a process of axial coding a pattern of causal relationships between categories and their properties was derived. Axial coding is defined by Borgatti (2008) as the process of relating coded categories of responses and their properties to each other, via a combination of inductive and deductive thinking. Comments made by the facilitator team, both informally in the weekly debriefing sessions and formally in the taped interview at the end of the semester, were useful in identifying relationships between response categories. Through an analysis of these relationships I was able to identify a core category (a good or poor experience of teamwork) to which almost all other themes or categories were linked. Borgatti (2008) explains that, following the guidelines of grounded theory, axial coding of qualitative data is followed by a process of selective coding which seeks to choose one category to be the ‘core category’ to which all other response categories can be conceptually related.

Analysis of student reflections suggested a tendency to say what they thought the lecturers wanted to hear or even to treat the reflection as an essay about PBL and / or

---

[72] Statistically, the results of a chi-square test are not valid where any expected value is less than 1, or more than 20% of the expected values have values of less than five. (http://www.okstate.edu/ag/agedcm4h/academic/aged5980a/5980/newpage28.htm accessed 30 Nov, 2007). Using the original five point Likert scale, a number of values in the expected value table were very low.

[73] Borrowing from Grounded Theory (Dick, B. 2002, 'Grounded theory: a thumbnail sketch', Resource papers in action research, Accessed: 06-03-2006 at http://www.scu.edu.au/schools/gcm/ar/arp/grounded.html#a_gt_intro), a category is considered to be saturated when it appears in the data so frequently that there is little value in continuing to code it.

teamwork. Brodie (2007) working at the Faculty of Engineering and Surveying at USQ described the same experience in the early years of introducing PBL which she addressed through the development of a guide to reflective writing. Noting Brodie's experience, team facilitators had been careful to stress to students the importance of objectively reflecting on their experience not only for their own benefit and growth but in order to inform improvements in course design for future years. Nonetheless, I felt the tendency remained.

The concept map below (Fig. 5.1) describes and summarises the categories emerging from the data and their relationships and represents the end result of the qualitative analysis undertaken. This representation of emerging themes/categories and their relationships also effectively summarises the research findings from 2005 which are discussed in more detail in the sections to follow.

5.1.1 An Explanation of the Concept Map

The concept map (Fig. 5.1) is divided into two halves to represent the factors in the learning environment that contributed to a successful implementation of PBL (right side) and those that were an impediment to learning and/or skills development (left side). Some students had a negative experience of teamwork. Recurring themes were a workgroup approach to working as a team, the effective absence of a shared language stifling communication within the team, social loafing, interpersonal conflicts, and team leaders assigning tasks based on pre-existing skills so that team members were denied the opportunity to develop new skills. This latter tendency appeared to be attributable to ultra-competitiveness with team leaders not wanting to risk team marks by giving work to team members without proven expertise and also revealed itself in situations where team leaders did not want to accept contributions from team members with poor English or perceived lesser academic ability (involuntary social loafing). In the worst cases, team leaders took over assignments doing all the work themselves. Peer assessment was not successful as a mechanism to reduce social loafing (voluntary or involuntary) as students were extremely reluctant to deprive others of marks. Student comments suggested that this was related to the collectivist culture of the student body. This same collectivist culture prompted senior students (in the year level above the group being studied) to give their time to conducting *Kuppi*..

On the positive side, there were teams who worked well together, learning from each other and developing a healthy team spirit. This enabled members to develop team leadership and teamwork skills and enhanced their knowledge of themselves and how they could work best in a team environment. Factors which tended to contribute to this positive experience of team work were the leadership style of the team leader, adherence to a code of ethics, and having lecturers facilitate team meetings. Having lecturers act as facilitators also reduced the power distance between students and academic staff which had a number of benefits including promoting dialog in lectures and enabling lecturers/facilitators to help in the resolution of team conflicts. Another factor contributing to a successful teamwork experience was the widespread recognition that teamwork skills were important in the local software industry. Students, focused on improving their employability, were prepared to put time and effort into skills development. Related to this, student groups who were able to communicate in English felt that the opportunity to practice their spoken English was a positive aspect of working as a team. The importance given to employer

-

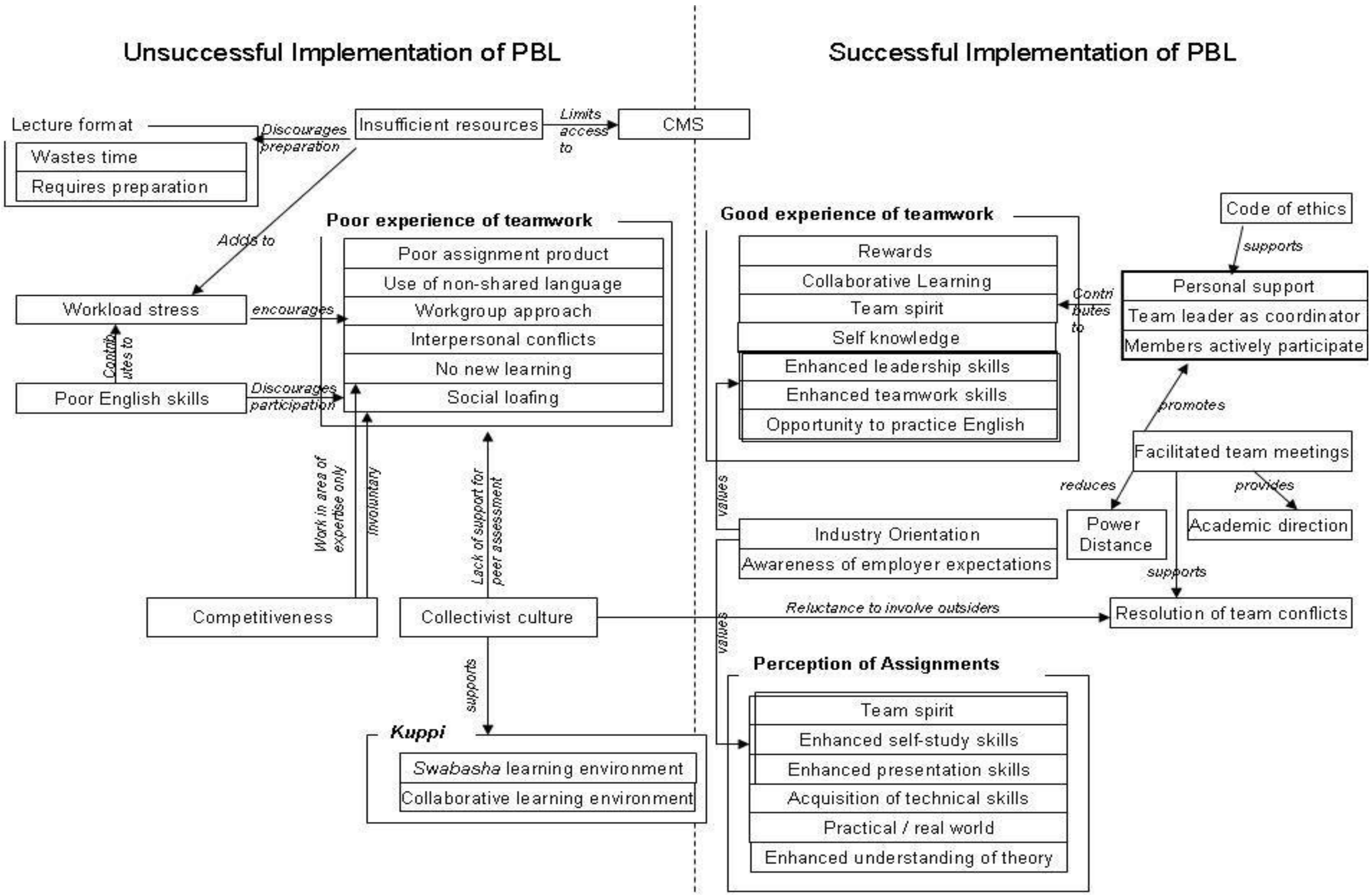


Figure 5.1: Concept Map of Categories emerging from the 2005 Data

expectations also contributed to students perceiving assignments positively - as opportunities to develop presentation skills, technical skills, self-study skills etc.

Table 5.1 provides a record of the quantitative data collected from the course experience questionnaires in 2005 and contrasts it with data collected in the 2004 baseline study. This data is referred to throughout this chapter.

Table 5.1 : Responses to Course Experience Questionnaire 2004 & 2005

STATEMENT		SD	D	N	A	SA	A+SA
Doing this subject helped me to develop my ability to work as a team member.	*2004*	2	7	13	19	5	*52.2%*
	2005	1	0	3	15	14	*87.9%*
I often made comments and asked questions in lectures.	*2004*	12	17	10	5	2	*15.2%*
	2005	0	3	14	13	3	*48.5%*
The workload was too heavy.	*2004*	1	10	9	20	6	*56.5%*
	2005	1	0	3	12	17	*87.9%*
Because there is so much work in this subject, it is difficult to understand it all.	*2004*	2	13	11	11	9	*43.5%*
	2005	2	1	15	15	0	*45.5%*
Doing this subject has improved my problem-solving skills.	*2004*	3	12	12	17	2	*41.3%*
	2005	1	6	7	12	7	*57.6%*
To do well in this subject, all you really need is a good memory.	*2004*	4	2	7	17	16	*71.7%*
	2005	0	9	8	10	6	*48.5%*
My spoken communication skills are better as a result of doing this subject.	*2004*	5	15	15	9	2	*23.9%*
	2005	2	5	9	12	5	*51.5%*
Doing this subject has improved my skills in written communication.	*2004*	1	2	17	19	7	*56.5%*
	2005	2	3	11	13	4	*51.5%*
After doing this subject, I feel that I understand how software engineering is used in the IT industry.	*2004*	2	3	17	16	8	*52.2%*
	2005	2	2	10	13	6	*57.6%*
I sometimes felt that my time in class was being wasted.	*2004*	5	10	15	12	4	*34.8%*
	2005	4	5	2	15	7	*66.6%*
I am confident that I could learn a computer package on my own (not going to a course).	*2004*	1	11	9	20	5	*54.3%*
	2005	0	6	7	17	3	*60.6%*
Students ideas and suggestions are always considered in this subject.	*2004*	9	7	15	11	4	*32.6%*
	2005	1	2	8	16	6	*66.6%*
Overall I was satisfied with the quality of this course.	*2004*	0	3	18	18	7	*54.3%*
	2005	1	3	9	17	3	*60.6%*

SD-Strongly Disagree, D-Disagree, N-Neutral, A-Agree, SA-Strongly Agree n=47(2004), n=49 (2005)

While Table 5.1 points to a number of interesting outcomes, results of statistical significance include a perception that the 2005 course was more successful in developing teamwork skills and spoken communication skills. The learning environment in 2005 also encouraged more students to make comments and ask questions in lectures. Results that point to a failure of the course design to make a difference are also interesting. Students in 2005 didn't feel that they understood how software engineering was used in the IT industry any more than students in 2004, and they were even more likely to feel that their time in class was being wasted. The number of students in 2005 who felt that the course developed their written communication skills was less than the number who felt the same way in 2004.

5.1.2 Teamwork

It is apparent from the categories emerging from the axial and subsequent selective coding of the qualitative data (refer to concept map representation of emergent categories in Fig. 5.1) that the core response category was student experience of working in a team. Students who worked well together in a team tended to achieve better marks on assignments and to have a positive impression of assignments as vehicles through which they had the opportunity to develop skills valued by industry. In contrast to this, students who had a negative experience of teamwork for a range of reasons, often did not do well in assignments or even participate in doing assignments, and were more likely to consider self-study or participation in Kuppi as the most positive learning experiences encountered during the course.

In many cases, a personal orientation to success in the IT industry together with a greater appreciation of employer expectations gained through their experiences in the course, caused students to place a higher value on the enhancement of their leadership and teamwork skills such that they worked harder at teamwork and felt more positive about working in a team. The same factors also caused them to place a higher value on having the opportunity to practice spoken English skills in facilitated team meetings or develop oral communication skills through doing team presentations, again leading to a more positive perception of teamwork. The course design provided these students with a positive learning experience. Such students were more likely to feel that PBL benefited them personally. Generally, the course was an exciting and rewarding learning framework for students working in a supportive and collaborative team.

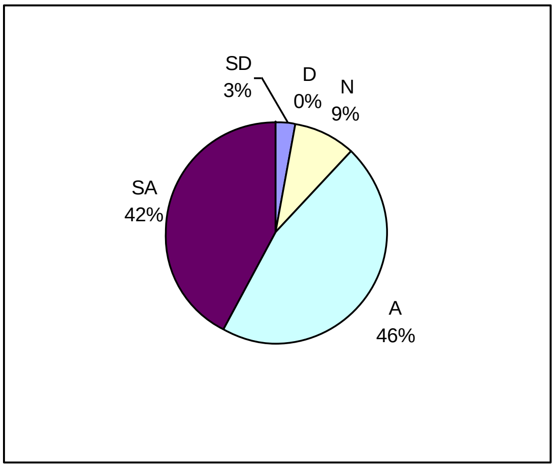
> I was very happy and felt very comfortable. I felt what a team can do when all the members are contributing in their 'top gear'.
>
> (Student Reflection 2005)

> I felt the power of the team. I was experiencing it. It was a great relation achieved through understanding each other.
>
> (Student Reflection 2005)

Others, excluded from this learning environment by a range of factors including poor English language skills, excessive individual competitiveness, or a lack of access to required resources (refer Fig. 5.1) were often left with an impression of being unfairly burdened by hard work as the result of social loafing by their colleagues and failed to gain many of the benefits of collaborative learning or team bonding cited by others. The manner in which the factors cited above contributed to a poor experience of teamwork are explained in detail later in this chapter. However, this reflection, written by a Software Engineering student in 2005, is representative:

> At the beginning I thought that this PBL will help us to learn efficiently. But now I'm totally fed up with this learning system. There are many reasons for that. This learning system is based on group work. But I think group work is the main curse for this university. All the students in this university have passed the G.C.E. A/L with flying colours. So they have ability to work individually. But in this system we are given group works. But most of the team members are not doing any group work. Instead of that they are playing fool here. We are given lot of materials about how to do the team works and also we have code of ethics. But no one cares about that material. Some days I didn't sleep whole the night and did the entire group work. But our group members didn't care about it. Somehow they want to get marks. If I assign works they don't do anything and they spend the nice time in the university. It is very difficult to get done any work from our group members. Because they know somehow we can get marks. Not only this thing I have concern about my studies also. So I totally against with this learning system.
>
> (Student Reflection 2005)

On the whole, most students indicated that they had had a positive teamwork experience. 88% of students undertaking the course in 2005 agreed with the statement *Doing this subject helped me to develop my ability to work as a team member* compared with 52% of the baseline students - a difference significant at the P=.005 level (Table 5.1 and Fig. 5.2).



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 5.2: Student response (2005) to the statement,
"*Doing this subject helped me to develop my ability to work as a team member*".

However, even amongst those students who reported a positive experience of teamwork, not all teams started off well. A number of student reflections described bad experiences at the start of the semester with social loafing (refer to Chapter 4) and interpersonal conflicts being predominant themes.

Three of the nine teams were able to overcome poor starts to achieve a high-performing teamwork environment. Their experience was consistent with Tuckman's "forming, storming, norming and performing" model of team work (Levin 2005).

> Our first team work for software engineering is web site. That time few members were came and did the works. Others didn't come to the faculty at weekend days. This situation also affected my mind. Our rest of the team members also feel like this. After this incidents we tried to advise to the absent members, they also feel sad about their characteristics in past. Now they are giving their full corporation to our team works. Our code of Ethics was useful in this situation, because our code of ethics says if a member is not giving support to our team works, we should advise to that person. That's why we advised to those members. So our code of ethics was useful here.
>
> Our second team presentation for software engineering, that time all members were came and did the presentation works. Even weekend days. We were got great success for this presentation team works. I learned to work with team members and I am very happy from this group work. I think other members also feel like this. We are getting good experience from this work. I believe that the experience I gained throughout this team work will definitely help me when I go to the industrial.

(Student Reflection 2005)

In the above case, the team was able to resolve their differences using their Code of Ethics (refer to Chapter 4). In other cases, team facilitators were able to help open up a dialog between team members to discuss issues such as freeloading. In only one instance did a problem escalate to the point where it could not be resolved with the intervention of the course lecturer/facilitators. In this case, the Dean of the Faculty had to intervene to resolve conflict and this happened because a student of another university (the boyfriend of the team leader) came onto campus and became involved in a dispute with team members.

An awareness of employer expectations and a strong industry orientation emerged as themes from student feedback in 2005 (Fig. 5.1) and contributed to students perceiving teamwork assignments as a valuable learning experience. Comments such as this one were typical:

> I think the most valuable thing that I have learned through this subject is the team working. Although I've had lot of previous experiences in team working, this time I had

> got totally different works to do and the people I'd got also little bit different from others I've met earlier. So I had to act various roles to satisfy individuals. Now I know that I'll have to act the same way in the industry, because I'll have to work with multifarious persons who have various attitudes.
>
> (Student Reflection 2005)

As a result, students appreciated the fact that the team leadership changed with each assignment, giving more students the opportunity to experience being a team leader as well as a team member. Prizes were also given to groups achieving first, second and third place in assignments and these prizes proved to be rewarding both as a recognition of success and also as an opportunity to celebrate. In team building, celebrating achievements is an important part of creating "social infrastructure" for the team (Levin 2005) and, for this reason, teambuilding training during the semester emphasised the importance of celebrating. While students claimed not to have enough time to celebrate between assignments, in sharing their prizes, they were nonetheless celebrating.

5.1.2.1 The Contributions of Assignments to Team Bonding

The first and second assignments (refer Table 5.2) proved to be valuable working environments for forging strong team bonds.

Table 5.2 : Software Engineering student assignments 2005

Assignment 1	Students constructed a team web site containing their own profiles (including their preferred team role and how they would contribute to the team), their Code of Ethics, their team name, logo and slogan.
Assignment 2	Students presented a case (through a group presentation) for using a particular Software Process Model to develop a given software application. Each team was given a description of a particular case study describing a client and their software needs (there were five different case studies in all allocated randomly to teams). Teams selected an appropriate software process model to be used to develop the software and defended their selection.
Assignment 3	Students created a Software Requirements Specification (SRS) for an actual Colombo-based training institute named the Academy of Design. This assignment was structured to follow industry practice in that students were provided with a general description of the required system written by the client (the tender document) and were then invited to meet with the client to ask any questions they might have in an open meeting with other bidders for the tender (the Bidders' Conference) and were finally invited to write and present the SRS.

In constructing a team web site (Assignment 1) there was an opportunity for those with experience in web site development to tutor their colleagues. The attendant opportunity to develop technical skills in web site development was frequently reported by students as a benefit of undertaking the first assignment. The experience of learning from each other also facilitated team bonding, opening up avenues of communication between team members which thereafter continued in the form of peer coaching and the sharing of ideas.

> I can remember a good incident of what happened when we were building the website. …The team members who never even have seen a web designing software were performing very well in performing their tasks. Those who never knew about the web designing software were given a brief knowledge about that software by those who knew the stuff. So we exchanged our knowledge between each other. We were really glad to see our website being built step by step. … I felt too glad on the day we finished the web site. I think there is nothing we cannot achieve if we did try to. We started as people who knew nothing about the website designing. But we studied harder and now we are junior experts. Working as a team rather than working alone will improve our personnel skills and also would show our personnel weaknesses. So that is more advantageous to behave as a team. In the real world we can use this technique in a proper manner. If we see that we can't understand something, we can ask others' opinion about the matter. We can get their advice as we learnt the web designing software "Dreamweaver" from others.

(Student Reflection 2005)

Those teams who took the alternative approach of allowing the one or two members with pre-existing technical expertise to construct the entire site ended up with inferior products although, in at least one case, this was an incentive to change their approach to teamwork for the next assignment. This tendency to assign team tasks only to those with existing expertise, appears to stem from the competitive approach to learning which characterises the student population. This attitude is scarcely surprising given the competitiveness of the education system in Sri Lanka described in Chapter 3. Competitiveness emerged in group work as an unwillingness to trust others in the team to complete work to the required standard. Equally, less able students or students with poor English language skills, are reluctant to contribute to group work for fear of letting the group down. In the concept map (Fig. 5.1) above, this is represented as involuntary social loafing.

Other teams who assigned one web page to each team member (a typical cooperative workgroup approach to doing written assignments) ended up with ill-matched web pages which did not link effectively. The fact that the effects of lack of coordination within a team is more immediately apparent in a web site than in a standard written report, was a benefit of requiring students to develop a web site as their first assignment. Where this happened, it was an incentive to communicate more with fellow team members and to do better next time.

> Our leader breakdown the works and gave them to us. He decided to collect all parts and prepare the final output (web page). We did our parts best as we could. But no one think about the others works. And finally add all the works of the members and prepared the web page. But there was no interconnection between those web pages. We all understand this is not the way to do team works.

(Student Reflection 2005)

In the second assignment where the deliverable was a team presentation, the process of practicing the presentation and critiquing each others' performances proved to be a good team bonding exercise for some teams. Other teams who found difficulty in getting together to practice, delivered a poor performance and were often penalised for running overtime. Again, in some cases, this acted as an incentive to work better as a team at the next opportunity.

> This was happened while we are creating the presentation for the assignment. We work as a team to gather information to create the presentation. We were able to share the parts very well, so each member could do their part up to the best standard. We practice the presentation as a team more than eight times; therefore we had lot of time to correct our mistakes. Everyone give comments on others about how the thing should change, how we should speech in front of others and so on. We had very innovative ideas during that time, as result of our good team spirit. Because of the team work and the good practicing we were able to do the presentation within time and it was very successful one. It was the best presentation I did in my whole life, I was so happy about

> me and all other team members. All the other member in the team also very happy about the presentation as I am. Our confidence was very high after doing the presentation. Everyone's moral was very high.
>
> (Student Reflection 2005)

Finally the third assignment was structured so that different members of the team had access to different resources and had to pool their knowledge to complete the assignment in the time available. For instance, only one member of the team was invited to meet the client. His/her responsibility was to ask questions on behalf of the team to ensure that they had a full understanding of the client's requirements. The other team members had a responsibility to research an appropriate format for the SRS. In most cases this resulted in collaborative work as reflected below although some of those who met the client reported having difficulty conveying their understanding to other team members.

> I went and got the requirements [from the client] and I came and taught the others saying this is what the software is about and this is how it should be...When it came to our group we shared everything with the others what we found. What we got from the net, from a software we found, or SRS templates, everything was given. No one kept the knowledge to them selves. There were a lot of resources available so anyone who wanted could have done it if some one actually wanted it.
>
> (Participant, Focus Group 2005)

5.1.2.2 Understanding of Team Roles

In focus group sessions, students were asked to comment on the skills that they felt a team leader should have. In Chapter 3, it was established that students might be expected to have a preference for hierarchical, workgroup-like structures given that this was the role model to which they were most frequently exposed. Instead they espoused a more collegiate approach with desirable traits of team leaders including things such as 'should be motivating … should be patient … should understand each person in the team' (pers. comm. Participant, Focus Group 2005). As team members, they were aware of the importance of sharing knowledge and participating in group activities, saying things like, 'All members should actively participate … It's not one person, all must talk' (pers. comm. Participant, Focus Group 2005). However, team leaders were seen as having the ultimate responsibility for ensuring team success even if it involved 'scolding'[74] or nagging uncooperative members or, indeed, doing the work themselves where the contributions of others were below the accepted standard or not forthcoming.

> <u>Moderator:</u> What makes a good team leader?
>
> <u>Participant:</u> Team leader have to kind of chase the people. To chase them. To remind them. Are you ready? Are you ready? Are you ready?
>
> …
>
> <u>Moderator</u>: Do you all do [teamwork] that way?
>
> <u>Participant</u>: We divide the work load and do it. For example, if I think it's this one's part, if it doesn't reach to my expectations it becomes a big problem. I overwrite it and do it all alone. This is the reason we got the highest mark.
>
> (Participants, Focus Group 2005)

5.1.2.3 Contribution of Facilitators

Team facilitators were able to structure the learning experience for students by helping teams to resolve team conflicts and by providing academic direction.

[74] 'Scolding' is a term often used in Sri Lankan English meaning to castigate or reprimand.

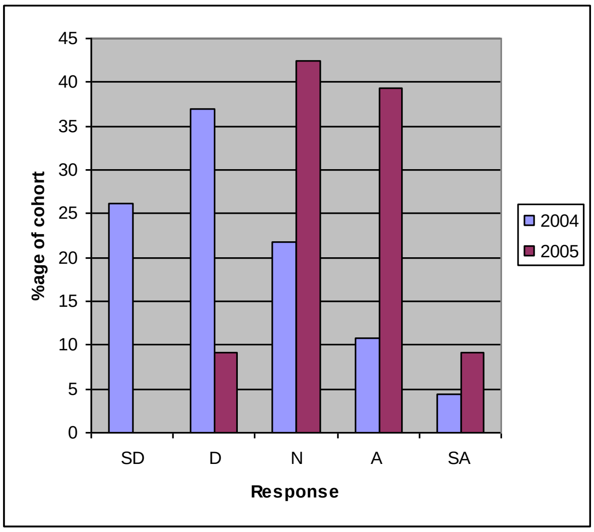
Students reported feeling reassured knowing that a lecturer was available to explain what was required in the assignments and that they were not expected to work completely alone.

Facilitators, consistent with research findings in other PBL settings (Wilkerson 1996; Hung et al. 2003), found it difficult to know how much help and direction to provide although one of the facilitators commented that the role of challenging students to find the answers for themselves was consistent with what he tried to do in his courses generally although, prior to this course, his attitude had prompted some student opposition as they were not used to it (De Mel, G. 2005, pers. comm., April 28).

> The discussions with the group and with the lecturer about the subject was interesting. We learnt about many industrial related aspects through the group activities. We clarified many subject related doubts that never could have been solved.
>
> (Respondent, Course Experience Questionnaire 2005)

The power-distance barrier which had been expected to exist between students and lecturers (refer to Chapter 3) was not evident, with students claiming that they found it easy to approach lecturers. This was the response in all three focus groups – Sinhala, Tamil and English-medium. Focus group participants attributed this to lecturers being young and approachable but the difference between the atmosphere in 2005 and that of the previous year with the same lecturing staff suggest that the small group learning environment may have had some influence.

> I think we got a lot of new experience through the new PBL learning method. I never learn that kind of education system. And also it is very attractive to me, because our lectures very close to us like our friends. I can ask any question from them and can solve it.
>
> (Student Reflection 2005)



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 5.3: Comparison of 2004/2005 student responses to the statement, "*I often made comments and asked questions in lectures*".

Facilitators themselves appreciated being able to establish rapport with students who would not normally have approached them outside the lecture hall (Thiruvilangam, Y. 2005, pers. comm., April 28). The greater perceived approachability of lecturers resulted in 48.5% of students in 2005 agreeing with the statement, *I often made comments and asked questions in lectures* (Fig. 5.3) compared to 15.2% in 2004 (Table 5.1), a difference significant at the P=0.001 level.

Facilitators were also able to reinforce student awareness of the value of soft skills desired by industry employers. As lecturers at FIT, the facilitators were in regular contact with industry representatives and thus aware of employer requirements in terms of graduate skills. The facilitators had also discussed the industry survey conducted by myself and Dr. Madurapperuma (refer to Appendix A) with me.

5.1.2.4 Peer Assessment

The peer assessment (PA) instruments used in 2005 were described earlier in Chapter 4. Student reaction to the use of these PA forms in 2005 was guarded with 18% of students failing to return the forms. However, what feedback was received, varied between the Sinhala and Tamil-medium groups. When asked for feedback in focus group sessions, all but one student in the Sinhala and English-medium groups said that they were reluctant to heavily penalise fellow team members even though their contributions during the semester might have been minimal.

> Moderator: You mean you don't feel good about it (peer assessment)?
>
> Participant : Yes. Now for example, if this one doesn't work we can tell him you are not working in the team this is not going to work. etc but its between just the two of us. But cutting marks is not the right thing. Lot of children didn't like this way. He got a reduction of marks compared to others - something he would feel.
>
> (Focus Group 2005)

The response in the Tamil-medium focus group was somewhat different with PA being endorsed because otherwise students 'would never learn anything because they are getting marks by doing nothing' (pers. comm., Participant, Tamil-medium Focus Group 2005) and because it was felt that otherwise freeloaders would never change their ways. However, concerns about whether PA would affect friendships were also raised. Students in all three focus groups expressed uncertainty as to how, or if, peer assessment ratings (PAR) would be incorporated into the final grade. An analysis of PAR (Fig. 5.4) for the third assignment – after facilitators had repeatedly explained the function and benefit of PA - showed that most students continued to award nearly full ratings to fellow team members with little variance across the group. This was inconsistent with qualitative feedback indicating social loafing in more than one-third of student reflections.

Figure 5.4 shows the combined PAR received by each team member in the named team. Error bars show the standard deviation of scores awarded for the particular person. In many cases these error bars are too small to be detected as the variance in scores is negligible. Missing points in some graphs illustrate cases where people failed to return PAR forms.

5.1.2.5 Teamwork overview

In summary, the primary themes associated with a positive team experience were rewards in terms of high marks and prizes, a sense of team cohesion labelled by some of the students as "team spirit", and a perception of gaining skills and knowledge from the teamwork experience that would be valuable in their later professional careers.

In contrast, negative experiences of teamwork were associated with poor results, team leaders who imposed a workgroup approach on the team function, excessive

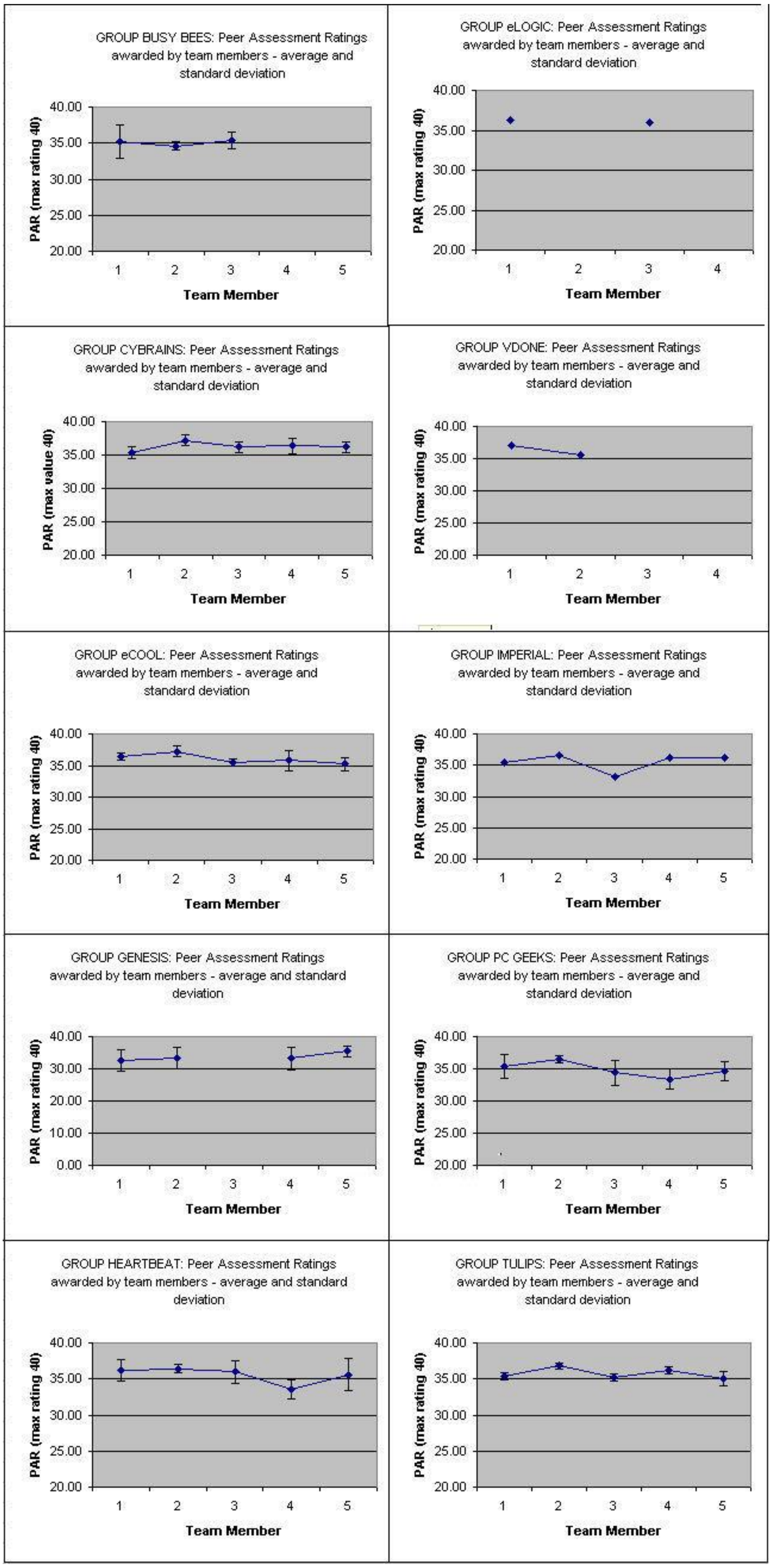


Figure 5.4: PARs awarded within student groups for Assignment 3 (2005)
(NOTE: Error bars on graph show standard deviation of scores awarded across the team)

competitiveness leading to team members either being restricted to working in areas of pre-existing expertise or, in some cases, being completely precluded from contributing to team assignments, and interpersonal conflicts often related to social loafing.

The involvement of lecturers as facilitators in team meetings was valuable in providing students with academic direction and support and reinforcing the value of soft skills in the software industry. Facilitators were able to intervene in the rare cases where student teams were not able to resolve interpersonal conflicts through other means such as the use of their Code of Ethics.

Most students did not use PAR to reduce the grades of non-contributing team members substantially although there was some support for PA couched in terms of helping fellow students to mend their ways for their own good. Some students claimed to be uncertain as to how, or if, PAR would contribute to the final grade and used this to explain their reluctance to use the tool.

5.1.3 Problem Solving

Facilitators discussed problem solving approaches with students (essentially the PBL approach described in Chapter 4) in the context of their assignments. Additionally, the assignments for 2005 (described in Table 5.2) were structured to walk students through a process of identifying and seeking answers to learning issues before considering possible alternative solutions. In the case of Assignment 2, students were asked to answer a series of questions before tackling the problem-solving component of the question. Assignment 3 was also divided into two parts with the first deliverable being a series of questions to the client.

Responses to the assignments in focus groups and on the Course Experience Questionnaire were overwhelmingly positive with the exception of pleas to reduce the workload. It was clear that students felt that the weekly tutorials with their required reading together with the three set assignments were too high a workload for most (particularly those with poor English). 88% of students responding to the Course Experience Questionnaire in 2005 agreed with the comment, *The workload was too heavy* (Table 5.1).

> Lecturers give us more work load than of what could be done. And the lecturers don't understand what is within us. There is a limit and a time period that we also can work. We fell sick due to the PBL. One person had a chest pain and the doctor has told it's because of the stress. (Participant, Focus Group 2005)
>
> Team working is good. But here we are over loaded because this team working. Our team leader got ill two times. I think because of this team working. In our faculty I don't think we have an environment for team working. In this small building we are stuck. Over loaded works stuck us more. Team working…….Now I am tired of hearing this word.
>
> (Participant, Focus Group 2005)

The excessive workload was a topic in all focus groups and commented on in many of the reflections and course participation questionnaire responses. It also invited gentle criticism from other lecturing staff.[75] As a 3 credit course, Software Engineering had been allocated a 2 hour lecture time slot and a 3 hour tutorial/laboratory time slot (refer to Appendix C), and generally used less than this

[75] Course facilitators reported being told by senior lecturers that students should be allowed time to relax and being reminded that Software Engineering is only one of eight subjects in the semester.

allocated time. There are no faculty guideline for the number of assignments to be given but two or three in a semester is the norm.

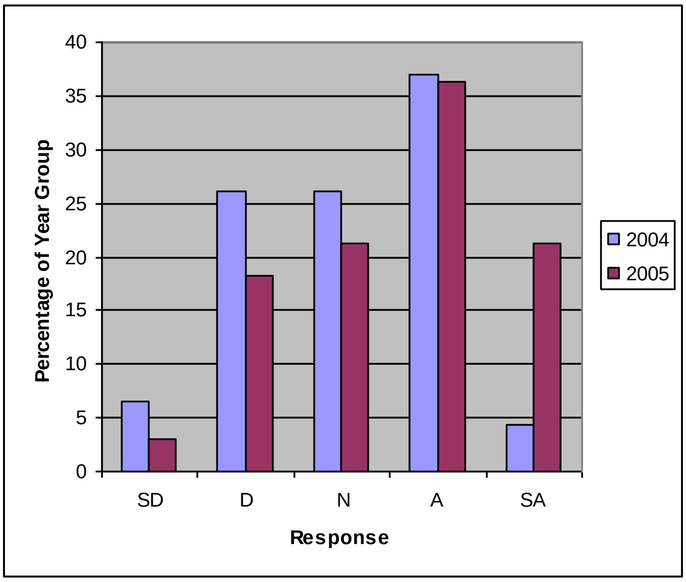
Nonetheless, categories or themes emerging from the axial coding of the data (summarised in Fig. 5.1) such as an appreciation of the opportunity to develop self-study skills, an appreciation of the practical understanding gained from tasks firmly situated in the real world, and an acknowledgement of theoretical understanding gained only after working on an assignment, endorsed the value of the assignments as tools for learning.

> It's good to have practical assignments. In a previous lecture the lecturer explained everything and gave notes, which was very good. But he didn't give any assignments or practicals. Because of that we were limited for the notes that he has taught us but we won't look for anything new. If we were given an assignment we will look for the information and the knowledge will be used. We can search the Google also and find information rather than studying what we have. When we study alone by sources we remember more.
>
> (Participant, Focus Group 2005)

> The course gave us a chance to do things really happening in the industry like doing presentations and writing a SRS. It was very helpful for me to understand the things that I should do in the industry. I gained practical knowledge by doing those things.
>
> (Participant, Focus Group 2005)

However, these comments contrast with the following remarks made by a student from the 2004 baseline group,

> I did not particularly like this subject since it was quite boring and even though I understood what was in the text book, it seems as if it is the same thing repeated over and over again under most topics – just expressed in slightly different ways. If someone can memorize, they could get good grades. Otherwise there is nothing much to understand or think about – highly theoretical subject. We had many assignments and a presentation. What happens in assignments is just expressing what is in the book in different words and in the presentation it was just a case of memorizing what you had to say because this is not a subject one could understand and talk about since its just pure theory – highly impractical. Maybe some interaction would improve things.
>
> (Respondent, Course Experience Questionnaire 2004)



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 5.5: Comparison of 2004/2005 student response to the statement, "*Doing this subject has improved my problem-solving skills*".

Moreover, most students felt that the course had enhanced their problem-solving skills. Responding to the Course Experience Questionnaire, 57.6% of students agreed with the statement, *Doing this subject has improved my problem-solving skills* versus 41.3% the previous year (Table 5.1 & Fig. 5.5). This difference was not statistically significant.

Fewer students (49%) in 2005 endorsed the statement, *To do well in this subject, all you really need is a good memory* than in the baseline study (72%) (Table 5.1 & Fig. 5.6). Again, the difference was not statistically significant. It also cannot be said whether the difference was attributable to the change in format of the formative assessment component of the course. However, while students had not sat the end-of-semester examination at the time of completing the questionnaire, they had no reason to expect that the format would be different to the previous year where the emphasis had been on recall of content. Student results for formative assessment in 2005 averaged 78% compared to 80% for students in the 2004 baseline study.

KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

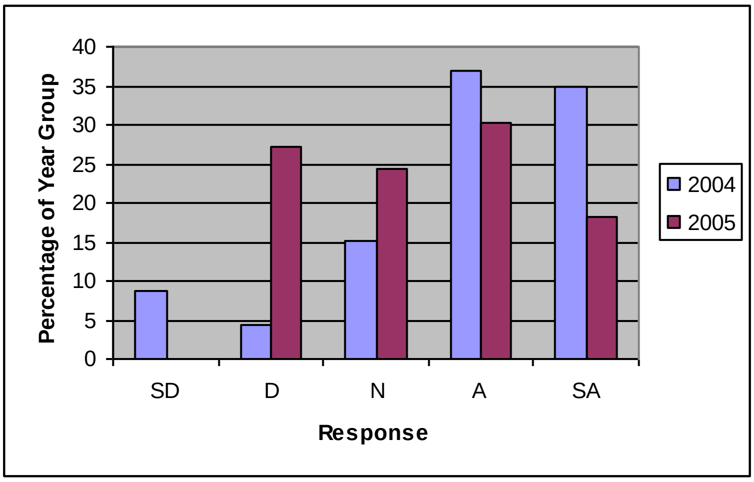
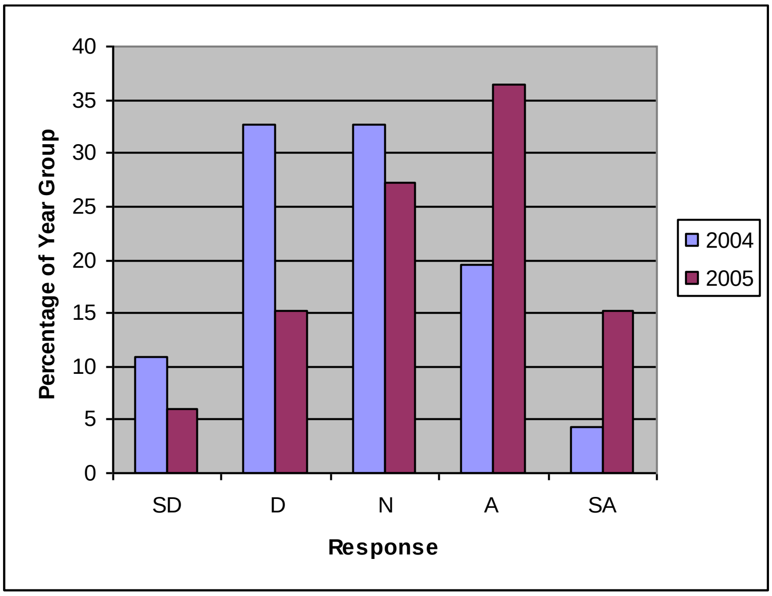


Figure 5.6: Comparison of 2004/2005 student response to the statement, "*To do well in this subject, all you really need is a good memory*".

5.1.4 Communication Skills



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 5.7: Comparison of 2004/2005 student response to the statement, "*My spoken communication skills are better as a result of doing this subject*".

Considerable effort was made in tutorial group sessions to improve student presentation skills looking at topics such as structuring a presentation, use of Microsoft PowerPoint™ as a presentation tool, effective public speaking, non-verbal communication, and making eye contact with the audience. These skills were subsequently assessed when students made group presentations in the second and third assignments. As a result, 52% of students in 2005 said that they believed that, *My spoken communication skills are better as a result of doing this subject* contrasted with only 24% the previous year - a difference significant at the P=0.05 level (Fig. 5.7).

However, a theme emerged from the data of poor English language skills which added to the stress of an already heavy workload and discouraged participation in assignments and in teamwork generally. As described in Chapter 4, teams were formulated to include students from different ethnic groups with a primary goal being to provide opportunities for discourse in English – the link language. In some cases, working in facilitated, mixed-ethnic teams did give students much appreciated opportunities to practice their English language skills. Other students, with poor English language skills, felt discouraged from participating in team work or were shut out of team discussions by the use of Sinhala. Comments made in each of the three focus groups indicated that English was not working effectively as a link language in most teams.

> I learnt most of the techniques for developing my communication skills by working as a team. That was very useful for me to improve my English knowledge. Because there was a Tamil student in our team so we tried to discuss the assignment in English rather than talking in Sinhala language every time.
>
> (Student Reflection 2005)

> Even if we talk to the Tamils in English, some times some of them don't know English well and had problems in understanding. …It's not their problem, in outstation places like Jaffna, Mannar etc. There they don't have English teachers like we have. Nor to learn English by watching T.V. that is the reason for them. Not that they are less knowledgeable. You cannot say they don't like Sinhalese people either. Because they work very well with us. It's only the communication skill barrier.
>
> (Participant, Sinhala-medium Focus Group 2005)

> We like to study in groups. But we at times face a problem when there are too many Sinhala speaking students. Because some important parts of the discussion would then go in Sinhala at times.
>
> (Participant, Tamil-medium Focus Group 2005)

Students who found it difficult to understand the course content in English, reported being reliant on *Kuppi*. Not unexpectedly, attendance at *Kuppiya* emerged as a saturated category in axial coding of student qualitative responses in 2005. The popularity of *Kuppiya* was verified quantitatively in 2006 (refer to Chapter 6).

5.1.5 Independent Learning Skills

In order to foster independent learning skills, the course lecturer challenged students to learn for themselves, devoting the lecture timeslot to answering questions from student teams based on their reading of the online lecture notes and the course textbook and their attempts at the online quizzes. The lecturer passed from group to group answering any questions posed by the teams. At the same time, students participated in exercises during tutorial groups focusing on study skills and awareness of their own learning style. As discussed in Chapter 4, it was anticipated that making students more aware of their preferred learning style would give them more control of their approach to study.

While a minority of students commented on the advantage of learning through small group discussions in the lecture timeslot, for example,

> I believe it is very valuable because as we were never used to self study during school time suddenly falling into self study is difficult. So a combination of self study, group discussion and lecturer interaction makes self study easy, brings hope that we too can really do self study and also enables us to get the right picture of the subject (by sharing our ideas with others).
>
> (Student Reflection 2005)

the overwhelming response was impatience with the approach. Rather than resolving problems within the team, students tended to wait for the lecturer to reach them thus wasting most of the lesson. Two-thirds of the class (66.6%) said that, *I sometimes felt that my time in class was being waste* compared to 34.8% in the previous year (Fig. 5.8), a difference significant at the P=0.005 level.

KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

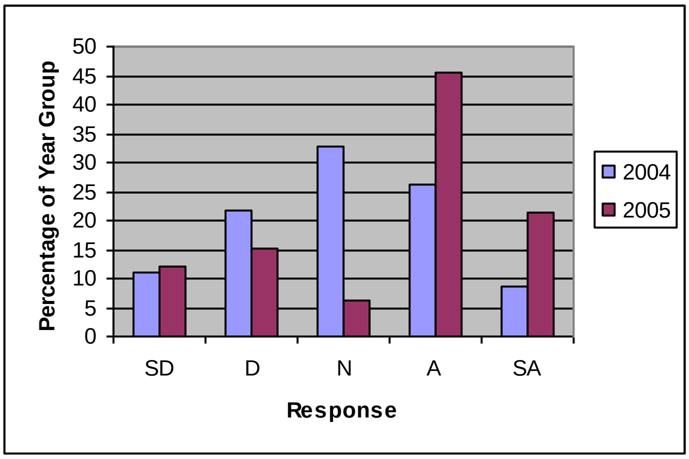


Figure 5.8: Comparison of 2004/2005 student response to the statement, "*I sometimes felt that my time in class was being wasted*".

In many cases, students had not done the required online reading before coming to lectures and were not able to gain anything from the exercise. This is consistent with electronic data records from the Moodle™ CMS which indicated that, after some initial enthusiasm in the first few weeks, most students left reading the online lecture notes and doing the online quizzes until their study vacation (termed 'reading week' in the local context) prior to the end-of-semester exam. After week three, less than 50% of students did the quiz during the semester; after week 6, less than one-third (Fig. 5.9). Figure 5.9 shows the number of quiz attempts made during the course of the semester and the total number of quiz attempts (quiz attempts made both during and at the end of the semester). The level of activity indicates a very low level of independent learning activity except for a peak close to exam time.

Quizzes were available for each course topic and included 10 multiple choice or true/false answer questions. For a student familiar with the topic and fluent in English, it is estimated that a quiz could be finished in 10-15 minutes. However, recognising the variation in English fluency, no time penalties were built into the quizzes. Marks were purely informational and not counted for the purposes of summative assessment. Examples of quiz questions are included as Figures 5.10, 5.11 and 5.12 below.

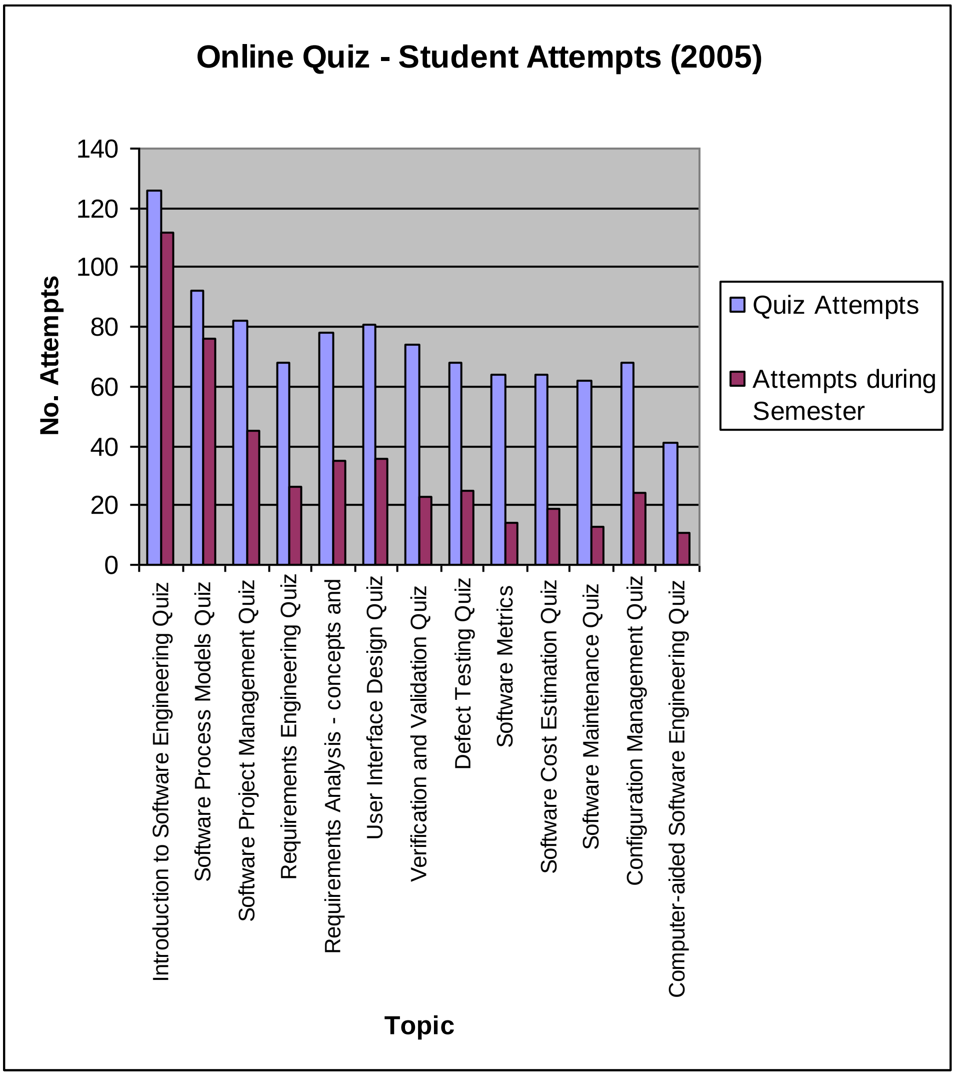


Figure 5.9: Student attempts at online quizzes during and at the end of semester (2005). (Note: Quizzes correspond to the weekly lectures with a new quiz being made available online at the start of each week.)

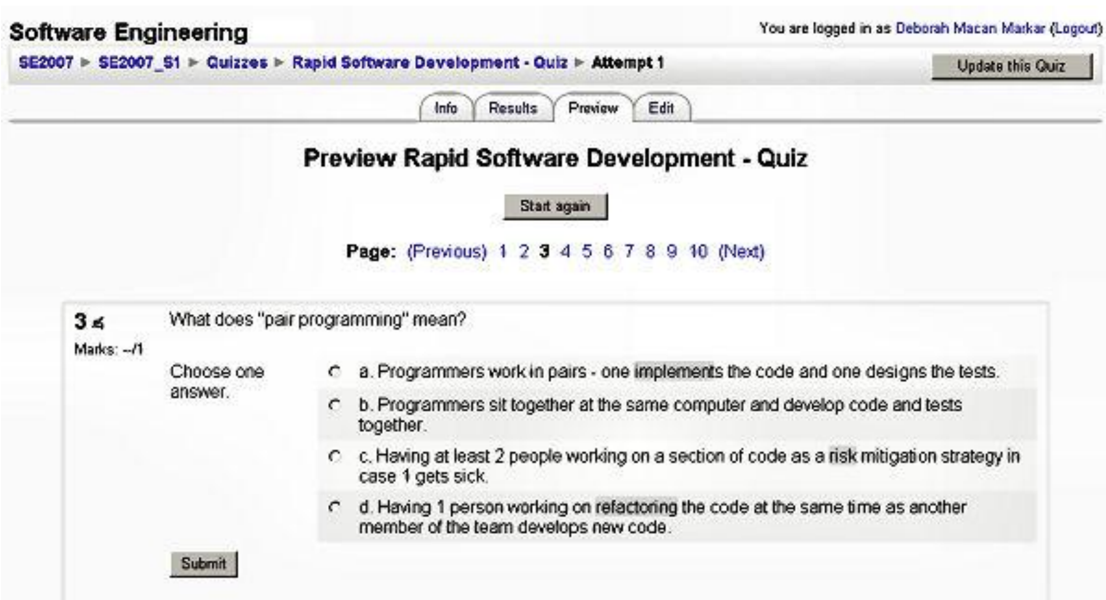


Figure 5.10: Example of an online quiz question targeting understanding of terminology

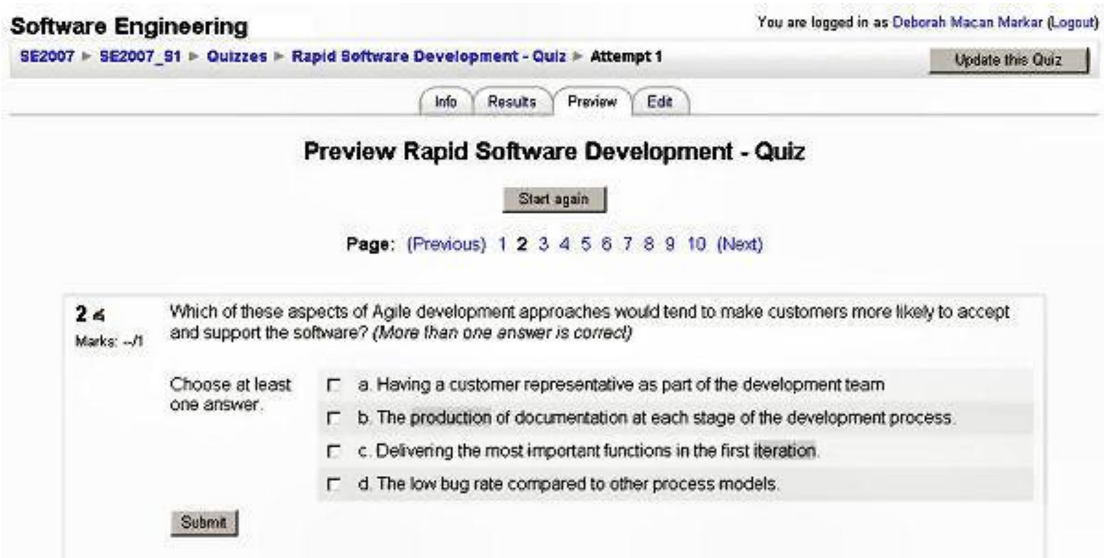


Figure 5.11: Example of an online quiz question targeting application of knowledge

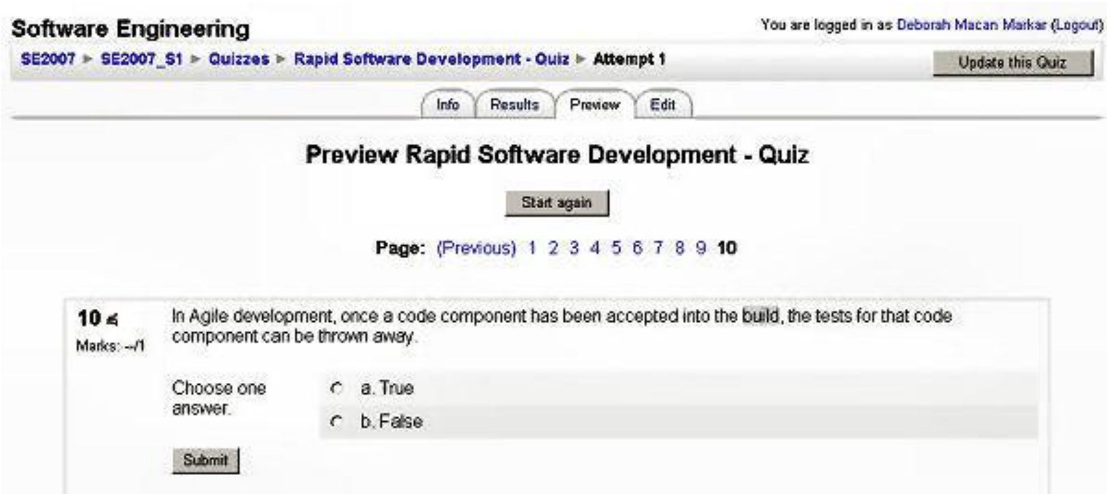


Figure 5.12: Example of a true/false online quiz question

In focus group discussions, students cited lack of resources as one reason why they tended not to prepare for lectures. The number of computers were limited and the textbook was regarded as difficult to read (discussed in Chapter 3).

> We had to read lectures on Moodle before attending the lecture. When I go to the lab for reading there are no enough computers. If I didn't read the lecture I can't understand anything because the lecturer also explaining several things only. My knowledge on software engineering is near to 0. I think a method like this for learning in a university like this is not suitable. If we had enough resources sometimes it may work. At last I have to say that this method of learning is good for the lecturers other than students. I propose that stopping this project is good for both. The all ideas I mentioned above are my own ideas about this project. If there is anything wrong I apologize you.
>
> (Student Reflection 2005)

In addition, labs were often congested and noisy, making it difficult to concentrate on lecture voiceovers. The other reason most frequently given was lack of time. Comments made in focus groups indicated that students with poor English had difficulty in coping with the large amount of reading the course involved. Students were required to read the online lecture notes prior to lecture timeslots and to read weekly material in preparation for the tutorial sessions.

5.2 Discussion

In discussing these results, reference is made to the objective of this study, i.e. to investigate how a PBL approach can be implemented effectively in the FIT context to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills.

In summary, data collected throughout 2005 suggested that the primary factors behind a successful learning experience leading to the development of problem-solving, teamwork, communication and self-study skills were:

- A positive teamwork experience with most, if not all, members, actively participating in the work of the team and sharing their knowledge and experience;
- Student awareness of employer expectations and a strong industry orientation;
- Support from facilitators;
- Practical, real-world assignments which challenged students to learn for themselves.

Working against students achieving the goals of the course were factors such as :

- A negative teamwork experience with unresolved interpersonal conflicts, significant social loafing and little to be gained in the way of new learning or skills because of a competitive workgroup orientation to teamwork;
- Poor English language skills making it difficult to keep up with the course reading load and contribute to team products;
- Insufficient resources, particularly networked computers;
- Excessive workload.

Students demonstrated that they had a clear idea of what skills a team leader and team members should have and these ideas reflected a team-orientation rather than the expected preference for hierarchical workgroup structures. Moreover a team-orientation was reflected in their actual approach to teamwork in the majority of cases with evidence of collaborative problem-solving in assignment work. Team facilitators substantiated that they observed steadily improved teamwork in many groups. Given that the pattern in the 2004 baseline study tended to be one of team leaders dividing the work amongst the team and then closely managing its production, it would appear that the majority of students in the 2005 cohort had better teamwork skills. In explaining his theory of constructivism, Piaget describes how the impetus to 'accommodate' new knowledge comes from an experience of failure or an experience of success doing something a different way (O'Donnell 1999). When this happens, knowledge which has been assimilated or brought into one's cognitive system is permanently accommodated there and can be used in another situation (O'Donnell 1999). Based on their own feedback and on facilitator observation, many students in 2005 appeared to have accommodated teamwork skills, arguably based on a person experience of successful teamwork. From student comments, it appears that an awareness of industry expectations and a strong orientation to the industry and its values were primary motivators for students to succeed at teamwork.

The other major success factor of the learning experience was the practical, real-world assignments which required application and synthesis of knowledge and independent research. Given that the 2004 baseline study established that students were not accustomed to being challenged to use higher order learning skills in assignment work, it would be reasonable to conclude that student were working at the limits of their Vygotskian "zone of proximal development" in at least some of these assignments. Nonetheless, they did as well in assignments in 2005 as they had done in 2004 and were generally positive about the impact of assignments on their problem-solving (Fig. 5.5), teamwork, independent learning and communication skills (Fig. 5.1). Their comments indicate that being able to seek direction from facilitators was reassuring and effectively scaffolded this part of the learning experience.

5.2.1 Design for Phase II (2006)

The next phase of the intervention into the Software Engineering course needed to be designed to ensure that the successful learning environment enjoyed by some students in 2005 was available to most, if not all, students in 2006. More students needed to experience the "power of the team" described above so that they could reflect upon and accommodate teamworking skills. In general, measures needed to be taken which reinforced success factors and addressed limitations experienced in 2005.

Unfortunately, during 2005, the first year intake to the faculty doubled and, in 2006, the faculty moved back to the main Moratuwa campus with attendant problems described in Chapter 3. At the same time, two of the three lecturer/facilitators from 2005 left to pursue further studies. Hence, it was no longer possible to assign facilitators to groups or to schedule a time or place for team meetings. The decision then became one of whether or not to continue with the teambuilding, study skills and communication exercises of the previous year assuming that students would be able to do them effectively with minimal lecturer / facilitator input. Bearing in mind the pleas of the previous year's students to reduced the excessive workload, a decision was made to reduce the number of tutorial sessions reasoning that it was, in any case, simply not possible to develop all the required soft skills in a single subject. Accordingly, the lecturer and I decided to cut back on all but teambuilding exercises and the basics of the PBL approach. The orientation to teamwork exercises on such topics as how to conduct team meetings or how to resolve team conflict were dropped since these were based on role plays and small-group discussion which were not feasible given the logistical constraints.

For the purposes of this study, student feedback on these exercises from 2005 could still be used to inform a model of an optimal learning environment (the theoretical framework referred to in the second research question) while cutting back on tutorial sessions and the associated reading would reduce the workload stress experienced by students in 2006. At the same time, the number of assignments was reduced from three to two by dropping Assignment 2 from 2005. Assignment 1, which involved the construction of a team web site, was retained because it provided an opportunity for students to reflect on their preferred team roles (as established using an online quiz at www.queendom.com) and negotiate a Code of Ethics – both important steps in teambuilding. Assignment 1 had also proven to be a good collaborative learning exercise in 2005 with students reporting that they discussed site design as a team and tutored each other in the technical aspects of website development where necessary. As preparing for the class presentation in Assignment 2 had also been a useful collaborative learning exercise in 2005, a presentation of the product was built into the third assignment in 2006. As in the previous year, students were asked to reflect on what they had learnt about teambuilding and problem solving at the end of the semester.

In the absence of facilitator guidance, there were also concerns about the approach that students might take to problem-solving. Accordingly, an orientation to problem-solving was given to the whole group drawing on resources provided by the PBL unit at Temasek Polytechnic. Temasek Polytechnic in Singapore conducts most of its courses using a PBL approach and makes a number of resources, such as the video used in this instance, available on its web site. Two of the lecturer/facilitators in the first year had attended a PBL conference conducted by Temasek in 2005 to work on their approach. Exposure to the Temasek video reinforced an introduction to problem-solving session that the same students had participated in during their first year project. In preparation for the second assignment (Assignment 3 in Table 5.2 above), it was decided to lead student teams through the process of drawing a concept map of the computing system they were being asked to design. The objective was to identify gaps in their knowledge which could be formulated into learning issues and subsequently directed to the client as questions in the first deliverable for the assignment.

In addition, several tutorial sessions were devoted to working through case studies representing typical problems faced by Software Engineers. A number of other practitioners had found case studies as useful tools (Dodge 1997; Abraham 1998; Jonassen 1998; Monday & Barker 2003) for building problem-solving capacity and we anticipated that they could be used in this context to practice the problem solving approach.

> Depending on the level of experience of the learners, the teacher may provide the groups with worked examples of similar problems or related case studies to build "case-based reasoning skills and enhance cognitive flexibility" (Jonassen 1998, p.223).

Tutorial sessions were scheduled for 50 students at a time with lecturers on-hand to answer questions with students encouraged to work collaboratively in teams. Tutorial sessions were held in a computer laboratory so that students were able to type their responses to the case studies into a discussion forum. Marks were given for the quality of responses and students were encouraged to build on responses made by other students rather than simply responding directly to the case study questions.

As strong orientation to industry values was a primary determinant of student motivation to improve their soft skills in 2005, efforts were made to reinforce this by making a series of videos with high profile industry employers talking about the importance of soft skills in the industry. These videos were made available through the Moodle site so that they could be watched and listened to at any time. Time was also allocated in the first tutorial session specifically for the purpose of watching the videos.

To help team leaders avoid the difficulties reported by the previous year group in getting their team members to meetings, time was allocated in tutorial sessions to allow students to work together on their assignments. However, it was expected that they would also convene team meetings outside scheduled tutorials.

Responding to negative feedback from the 2005 year group, the lecture format reverted to a traditional teacher-centred approach but with a number of measures taken to promote higher levels of interaction. Students were requested to sit in teams and lecturer questions were directed to teams rather than individuals. It was hoped that this would take the pressure off students with poor English while giving them a chance to help formulate team answers. At the same time, teams were regularly invited to ask questions of the lecturer as in the previous year but, as this was done in a normal lecture setting, the lecturer's answer could be heard by everyone. This addressed criticisms made in 2005 that only the group asking the question gained the benefit of the lecturer's answer. Inter-team quizzes were also organised with one team being asked to formulate a question on a segment of the lecture and to nominate another team to answer the question. The asking team then had the opportunity to listen to the answer and award points, thus introducing a form of peer assessment.

Headsets were provided so that students could listen to lecture voiceovers in the computer labs regardless of the level of ambient noise. To promote interaction with course content, student teams were asked to create and post additional quizzes on topics of their choice from the list of lecture topics. These were made available on the Moodle site for other students to attempt along with the quizzes constructed by lecturers.

Finally, an attempt was made to improve the effectiveness of peer assessment as a tool to combat social loafing by providing a rubric for the calculation of team and individual grades on the Moodle site. It was intended that this would answer uncertainties expressed by the 2005 cohort about the purpose and importance of peer assessment marks. At the same time, it was decided to try to improve the sense of individual accountability within teams (and hence lessen social loafing) by testing individual knowledge of the group product using a *viva voce* or oral examination. Students would be called in individually to answer questions which could be about any aspect of the group project. It was assumed that students who had participated in team meetings and in putting the assignment together, would be able to answer these questions more successfully than students who had not been involved or were only peripherally involved. It was hoped that this would encourage a higher level of collaboration on the assignment. *Viva voce* are commonly used as instruments of assessment in other courses and faculties of the university.

CHAPTER 6

Analysis of Phase 2 (2006) and Implications for Design of Phase 3 (2007)

The end of 2005 saw the conclusion of the first cycle of design, implementation, analysis and redesign in the study (refer to the study plan outlined in Table 2.1). In 2006, I commenced the second cycle by implementing the redesigned intervention. At this point I would like to reiterate Gorard's (2004, p.102) description of the steps of design-based research from Chapter 2 where he says that:

> [C]urrently accepted theory is used to develop an educational artifact or intervention that is tested, modified, retested and redesigned in both the laboratory and the classroom, until a version is developed that both achieves the educational aims required for the classroom context, and allows reflection on the educational processes involved in attaining those aims.

This chapter then presents an analysis of the findings of implementing the second version of the design after it had been modified to better achieve the educational aims outlined in the research question. It should be noted that there were also some significant changes in the context in which the intervention was implemented in 2006 which had to be accommodated in the design. The most significant of these was the move back to the Moratuwa campus and the doubling of the course enrolment, the ramifications of which have already been described in Chapter 3. Additionally, during the period in which the Software Engineering course was conducted, the lecturer left for 5 weeks and I took over her lecturing load. I also took on the task of co-supervising the second year project which involved the same group of students. Reference should be made to the discussion in Chapter 2 of the possible implications to the study of my more direct involvement with the students. Finally, FIT made significant changes to the syllabus at the end of 2005 based on consultations with industry. This had implications for students in 2006 since they were no longer able to seek assistance from their seniors in the third year of the course. The most serious impact of this was the inability of the third years to conduct *Kuppi* for the second year students (a common practice). Instead, students in 2006 had to rely on academic high-achievers in their own year group.

6.1 Data Collection and Analysis

As in 2005, 24 students participated in three focus groups designed to gauge student opinion about the course. In addition, all students attending lectures in the final week of the semester (79% of those enrolled) completed a course experience feedback questionnaire and each team submitted their reflections on learning and teamwork during the semester. As there were no team facilitators and the lecturer and I were in almost daily contact, no formal staff interviews were conducted. This chapter presents the findings from these data sources together with personal observations made during the semester. Once again, the themes against which the results are reported are the industry desired soft skills including teamwork, problem solving, communication and independent learning.

6.2 Results

As in the previous year, transcripts of focus groups and student reflections were coded for emerging themes / categories of data. The concept map in Figure 6.1 below illustrates the emergent saturated categories and their relationships. From a comparison of Figure 6.1 with the concept map drawn up following the analysis of data in 2005 (Fig. 5.1), it is immediately apparent that the course had an entirely different impact in this second iteration. While student comments in 2005 tended towards a positive impression of teamwork and assignments such that the concept map (Fig. 5.1) presented a balance between factors associated with a successful implementation of PBL and factors associated with a unsuccessful implementation of PBL, the student experience in 2006 was largely negative such that the equivalent concept map (Fig. 6.1) focuses almost entirely on an unsuccessful experience of PBL.

6.2.1 An Explanation of the Concept Map

Student feedback about the course in 2006 as evidenced in the concept map of emerging themes or categories (Fig. 6.1) was largely negative. Central to the concept map is the theme of workload stress exacerbated by a series of factors on the right hand side related to a perceived lack of staff support and a lack of resources (particularly access to computer labs). Both teamwork and assignments suffered as the result of students feeling overburdened with work. Assignments were marred by plagiarism and teams suffering from social loafing and a lack of CL opportunities. Students were very anxious about their professional future but this did not translate into extra effort being put into activities which might develop desirable soft skills as it had in 2005. Student were also angry about a perceived lack of control over their own learning, resenting faculty policies (such as the 80% attendance requirement) and faculty practices (such as lack of transparency in marking) which they saw as contributing to this.

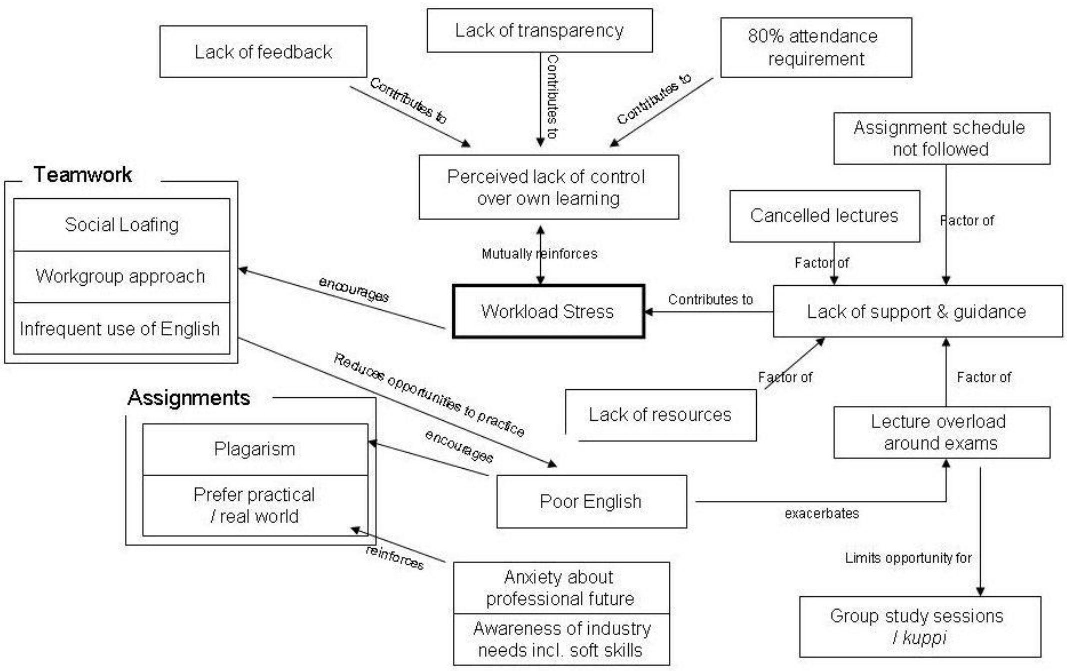


Figure 6.1: Concept map of emerging categories from 2006 data

Table 6.1 presents supporting quantitative data collected from the Course Experience Questionnaire. The table extends that presented in the previous chapter (Table 5.1) to contrast student responses from the Course Experience Questionnaires in 2006 with those in 2004 and 2005.

Table 6.1: Results of Student Course Experience Survey, 2004 – 2006

STATEMENT		SD	D	N	A	SA	*A+SA*
Doing this subject helped me to develop my ability to work as a team member.	*2004*	2	7	13	19	5	*52.2%*
	2005	1	0	3	15	14	*87.9%*
	2006	0	10	14	52	6	*70.7%*
I often made comments and asked questions in lectures.	*2004*	12	17	10	5	2	*15.2%*
	2005	0	3	14	13	3	*48.5%*
	2006	15	24	28	13	2	*18.3%*
The workload was too heavy.	*2004*	1	10	9	20	6	*56.5%*
	2005	1	0	3	12	17	*87.9%*
	2006	1	2	9	24	46	*85.4%*
Because there is so much work in this subject, it is difficult to understand it all.	*2004*	2	13	11	11	9	*43.5%*
	2005	2	1	15	15	0	*45.5%*
	2006	1	3	10	42	26	*82.9%*
Doing this subject has improved my problem-solving skills.	*2004*	3	12	12	17	2	*41.3%*
	2005	1	6	7	12	7	*57.6%*
	2006	3	28	28	21	2	*28.0%*
To do well in this subject, all you really need is a good memory.	*2004*	4	2	7	17	16	*71.7%*
	2005	0	9	8	10	6	*48.5%*
	2006	5	4	21	31	21	*63.4%*
My spoken communication skills are better as the result of doing this subject.	*2004*	5	15	15	9	2	*23.9%*
	2005	2	5	9	12	5	*51.5%*
	2006	7	15	22	24	14	*46.3%*
Doing this subject has improved my skills in written communication.	*2004*	1	2	17	19	7	*56.5%*
	2005	2	3	11	13	4	*51.5%*
	2006	2	13	22	34	11	*54.9%*
After doing this subject, I feel that I understand how software engineering is used in the IT industry.	*2004*	2	3	17	16	8	*52.2%*
	2005	2	2	10	13	6	*57.6%*
	2006	10	23	24	21	4	*30.5%*
I sometimes felt that my time in class was being wasted.	*2004*	5	10	15	12	4	*34.8%*
	2005	4	5	2	15	7	*66.6%*
	2006	1	5	11	22	43	*79.3%*
I am confident that I could learn a computer package on my own (not going to a formal course).	*2004*	1	11	9	20	5	*54.3%*
	2005	0	6	7	17	3	*60.6%*
	2006	5	22	29	16	10	*31.7%*
Students ideas and suggestions are always considered in this subject.	*2004*	9	7	15	11	4	*32.6%*
	2005	1	2	8	16	6	*66.6%*
	2006	9	24	28	19	2	*25.6%*
Overall I was satisfied with the quality of this course.	*2004*	0	3	18	18	7	*54.3%*
	2005	1	3	9	17	3	*60.6%*
	2006	17	29	27	8	1	*10.9%*

SD-Strongly Disagree, D-Disagree, N-Neutral, A-Agree, SA-Strongly Agree
n=47(2004), n=49 (2005), n=104 (2006)

6.2.2 Year typified by high levels of student stress

Despite the reflection assignments and focus group discussion guides being largely similar in both years (Appendix B), the themes that emerged from the data in 2006 were markedly different to those which emerged from the 2005 data. The core category in 2006 was workload stress (Fig. 6.1). Students studying Software Engineering in 2006 perceived that they were working under stress and with little support, direction or guidance from the faculty. Instead, many of their comments reflected a sense of having obstacles put in their way by faculty actions (cancelled lectures, assignment due date schedules that were not adhered to, lack of coordination between lecturers, lecture overload in the lead-up to examinations, and poor resources). They felt that they had little control over their learning environment with, reportedly, little feedback from lecturers about their assignments, lack of transparency about examination and assignment marks, and a newly enforced ruling that made it mandatory to attend 80% of lectures.[76] Their response to these pressures were to save time by plagiarizing, to use workgroup approaches to teamwork for the sake of expediency and to allow other members of their team to carry the load (social loafing or freeloading). They also turned to each other for support with small study groups and *Kuppi* becoming the main vehicles for learning in many subject areas including Software Engineering.

Despite the reduced workload built into the design for 2006, this second group of students still claimed that the workload was too high. 83% of them agreed or strongly agreed with the comment, *Because there is so much work in this subject, it is difficult to understand it all* put to them in the Course Experience Questionnaire compared to 46% the previous year (Table 6.1 and Fig. 6.2) and 85% of them agreed that *The workload was too heavy* – similar to the response from the 2005 group where 88% of students had agreed with this statement (Table 6.1 and Fig. 6.3).

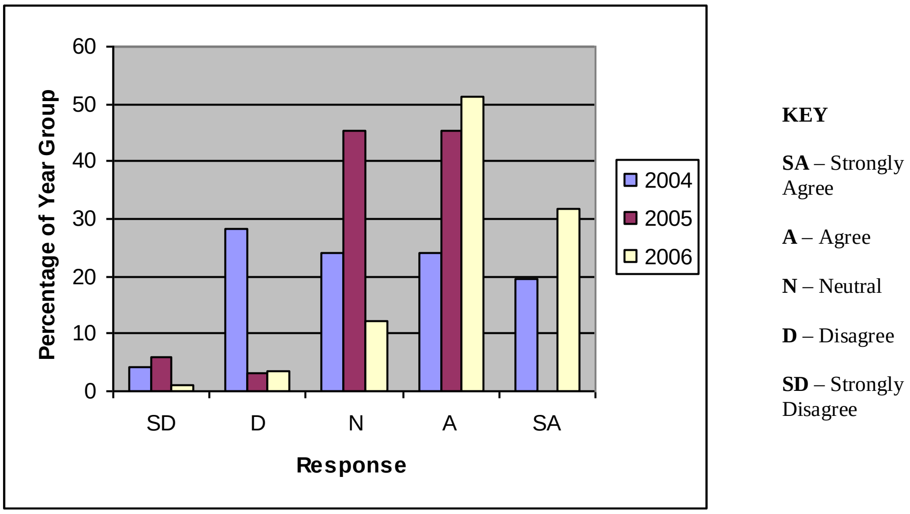
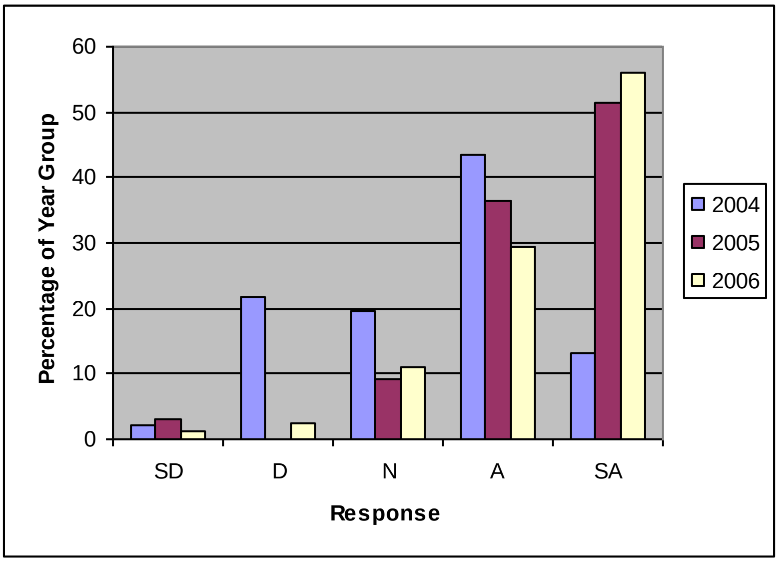


Figure 6.2: Comparison of 2004/2005/2006 student responses to the statement, "*Because there is so much work in this subject, it is difficult to understand it all*".

Some of the factors contributing to student stress were the results of the faculty move back to the main Moratuwa campus in 2006 as noted in Chapter 3. For a time, lecturers were in limbo with junior lecturers having no staff room or even desks in faculty buildings borrowed from the Faculty of Engineering and most staff expected to shuttle back and forth between campuses (up to one hour apart) by public transport. Internet facilities were not available in computer laboratories (again borrowed from the Faculty of Engineering) for most of the semester and local area networks were unreliable with servers crashing at regular intervals and requiring 3 or

[76] 80% lecture attendance exists as a regulation for all faculties of the University of Moratuwa but is not enforced in other faculties and was not strictly enforced in FIT prior to 2006. From 2006, students who did not attend 80% of lectures could not sit the end-of-semester examination.

4 days to be rebuilt.[77] On top of this, students were expected to be involved in a number of extracurricular activities such as the university's Fifth Anniversary celebrations and some social work in disadvantaged rural areas.



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 6.3: Comparison of 2004/2005/2006 student responses to the statement, "*The workload was too heavy*".

Some of the factors contributing to student stress were the results of the faculty move back to the main Moratuwa campus in 2006 as noted in Chapter 3. For a time, lecturers were in limbo with junior lecturers having no staff room or even desks in faculty buildings borrowed from the Faculty of Engineering and most staff expected to shuttle back and forth between campuses (up to one hour apart) by public transport. Internet facilities were not available in computer laboratories (again borrowed from the Faculty of Engineering) for most of the semester and local area networks were unreliable with servers crashing at regular intervals and requiring 3 or 4 days to be rebuilt.[78] On top of this, students were expected to be involved in a number of extracurricular activities such as the university's Fifth Anniversary celebrations and some social work in disadvantaged rural areas.

6.2.3 Teamwork skills

Students in 2006 were noticeably less enthusiastic about their teamwork experience than students in 2005 with 71% agreeing that *Doing this subject helped me to develop my ability to work as a team member* compared to 88% of students in 2005 (Table 6.1 and Fig. 6.4). This was not significantly different to the 2004 baseline response however, it was also not significantly different to the 2005 response.

Students recognised the importance of soft skills such as teamwork to IT employers and, as in 2005, were highly motivated to achieve in anything that might give them a competitive advantage at the start of their professional careers. In 2006, they were provided with videotaped footage of industry leaders talking about the importance of

[77] The server hosting the Moodle site for this course crashed towards the end of the semester losing all resources including student submissions to the case study discussion forums. University technical staff were unable to restore the site from backups.

[78] The server hosting the Moodle site for this course crashed towards the end of the semester losing all resources including student submissions to the case study discussion forums. University technical staff were unable to restore the site from backups.

soft skills. These videos clearly had a significant impact on students, as the following quotation illustrates:

> It was a new experience. It was interesting to listen the industry people. They revealed most of the soft skills that we should have as IT professionals. Most of those mentioned skills were new to me. Because I didn't think that these are that much interesting.
>
> (Respondent, Course Experience Questionnaire 2006)

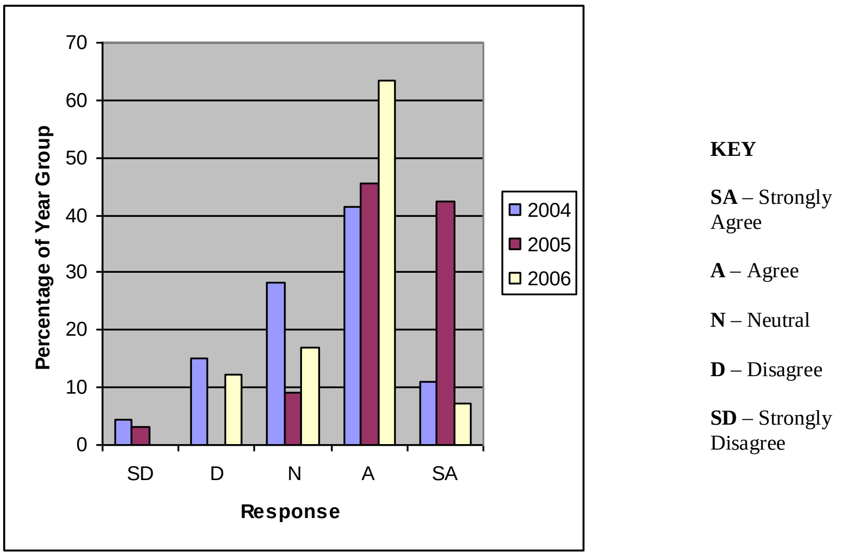


Figure 6.4: Comparison of 2004/2005/2006 student responses to the statement, "*Doing this subject helped me to develop my ability to work as a team member*".

Responding to a question in the Course Experience Questionnaire which asked students to nominate which of their tutorial sessions they perceived as being most useful, far more students (51%) selected the tutorial where they watched these videos than any other tutorial.[79]

However, despite this, of the 21 student groups in 2006 that submitted reflections on teamwork, only four reported establishing a genuine team working environment. One of these groups described their experience as follows:

> This was the first time we worked as a team. It was new experience for all of the members. Preparing the web site was the first assignment we suppose to do. The members were not well aware about them selves. Most of them work alone and do what ever they assigned to do. "TEAM" concept is an alien thing to them.
>
> It was very hard to work with others who have different views, ideas and opinions. During the first week we were not capable of making one decision. It was a disappointing thing to work under that kind of circumstances.
>
> It was an awful thing to attend to group meetings. I felt it was a waste of time. 60% of what we have discussed ended up without a proper conclusion.
>
> After some time the guys interact well with each other. I have identified each an every members preferred roles and their liking. So it is very easy to take their contribution towards the team work. Most of the time they teach the things that others don't know.
>
> The assignments made us easy to identify our talents. And it revealed our abilities and our interests. It improved our communication skills because we use English during our meetings. We are functioning well at this moment as a leader I am very proud of my team.
>
> (Student Reflection 2006)

[79] The next most popular tutorial was one in which students were invited to create online quizzes in the Moodle CMS which could be then accessed by fellow Software Engineering students. 15% of respondents thought that this was the most useful tutorial they experienced.

However, the above was an exceptional response. Apart from the creation of the team web site (Assignment 1), most student responses in 2006 described high levels of social loafing, sometimes voluntary and sometimes involuntary where team leaders refused to allocate work to members whose ability they doubted. Of the 21 group reflections submitted, fourteen were coded as describing social loafing. When group tasks were divided by teams in 2006, it was generally done on the basis of pre-existing abilities thus limiting potential for individual growth. Students acknowledged that this was not the best approach to team work but claimed that they did not have the time to help fellow team members. Evidence of collaborative learning in 2006 was minimal.

> I couldn't give a fair amount of work to my group members. I couldn't divide the work in equal manner. Example is when we were developing the team website most of the things were done by me and the team members didn't have any improvement on it. And also I couldn't teach or give them the knowledge to them since because of the tight time schedules of our academic work.
>
> (Student Reflection 2006)

When questioned about desirable qualities for a team leader, responses included such things as 'ability to divide the work', 'ability to motivate others to get things done' or 'knowledge of the area'. This was in marked contrast to the more collegiate responses of the 2005 group described in Chapter 5.

Descriptions of the teamwork environment contrasted with descriptions of group study sessions held in the lead-up to exams.

> <u>Moderator:</u> Why do you study with friends?
>
> <u>Participant 1:</u> Because what we know we teach each other and what we don't know we can ask, we can enhance our knowledge when discuss.
>
> <u>Participant 2</u>: When we study with friends they bring different kinds of books that can be referred so when we do that we gain extra knowledge.
>
> (Participant, Focus Group 2006)

Because of the level of freeloading or social loafing in formal teamwork, the pressure on team leaders was extremely high. Team leaders found it difficult to get team members to attend meetings, partly because of faculty-sponsored extra-curricular commitments described in the earlier part of this chapter and partly because of academic work pressure. In 2005 team meeting attendance had not been an issue because most team meetings were timetabled meetings with facilitators. By cutting back on formal tutorial exercises in 2006 and freeing up tutorial sessions for team meetings in the two or three weeks leading up to an assignment due date, the course lecturer and I had thought to provide a similar level of support to student teams in 2006, but this measure had clearly been insufficient.

When teams comprised both Tamil and Sinhala students, there was less likelihood of the discussion taking place in English than had been the case in facilitated groups in 2005. When focus group respondents were asked which language they had used in team meetings, half of them said English with mixed groups and Sinhala with Sinhalese-only groups, while the other half said Sinhala in all cases with periodic summaries in English for any Tamil participants. Although some students in teams which used English acknowledged the benefits of doing so:

> <u>Moderator</u>: Don't you have a problem communicating with them [Tamil students]?
>
> <u>Participant</u>: I was benefited by it.
>
> <u>Moderator</u>: How?
>
> <u>Participant</u>: I improved my English. I thought to myself that I would spend time with them as well since it really helped me to improve in my English. The thing is when I'm

with Sinhalese students I would obviously speak with them in Sinhalese. Even now I have two in my group. In my earlier project there were three.

(Participant, Sinhala medium Focus Group 2006)

Tamil students, understandably, felt somewhat excluded in Sinhala medium team meetings where they received only periodic summaries.

The strategy of mixing male and female students to provide a realistic workplace experience also resulted in some unanticipated and undesirable outcomes.

Moderator:	Do you do the part given to you?
Participant 1:	For girls they only give to write minutes & typing.
Moderator:	Why do they have difference in work for boys & girls – Why is that?
Participant 2:	No not in our group.
Moderator:	Why only in her group, hardware means boys & typing girls why?
Participant 1:	That is how it should be – they give us only what we can do.
Moderator:	What work do you give for girls?
Participant 3:	Actually we don't give any work.
Participant 4:	They give the paperwork to girls & they take the programming.

(Participant, Focus Group 2006)

Speck (2003, p.60) notes that the 'literature on collaborative groups recognizes that gender differences can be the source of group difficulties, such as stereotyping women as secretaries and men as experts' and suggests assigning roles stereotypically associated with one gender, such as that of the secretary or the leader, to be rotated.

Given the results above, it was difficult to counter student arguments for team self-selection. Whilst students recognized that team selection by lecturers most closely replicated the situation they would face in the workplace, they argued that there were many advantages in allowing self selection of teams such as allowing friends or students from the same boarding house to form teams in much the same way as they formed study groups. Students argued that such teams would have better communication and would be better able to bring peer pressure to bear on freeloaders as this comment relates:

In our first term we were able to do the final project very well because they gave us the opportunity to choose our group members. Then the people who wouldn't get involved got cornered and there was a big issue within the batch. They realized that this happened because they won't work. So they also started working. These people have an attitude to delegate all their duties to those who are hardworking. But in the end they realize that only we gain knowledge because they don't get involved.

(Participant, Focus Group 2006)

6.2.3.1 Peer Assessment

With social loafing at such high levels, it might be expected that active team members would be more prepared to use peer assessment ratings (PAR) to penalise freeloaders. However, as in the previous year, the results of the PA exercise showed minimal variation in marks given across the team demonstrating that students still did not feel comfortable with penalising their team mates. This conclusion was supported by focus group responses. The graphs below (Figs 6.5 and 6.6) show the variance in PAR for the second and last assignment from 2006. The graphs show, for each group, the average PAR awarded by individual team members to other team members and the standard deviation of the PAR they awarded. Standard deviations

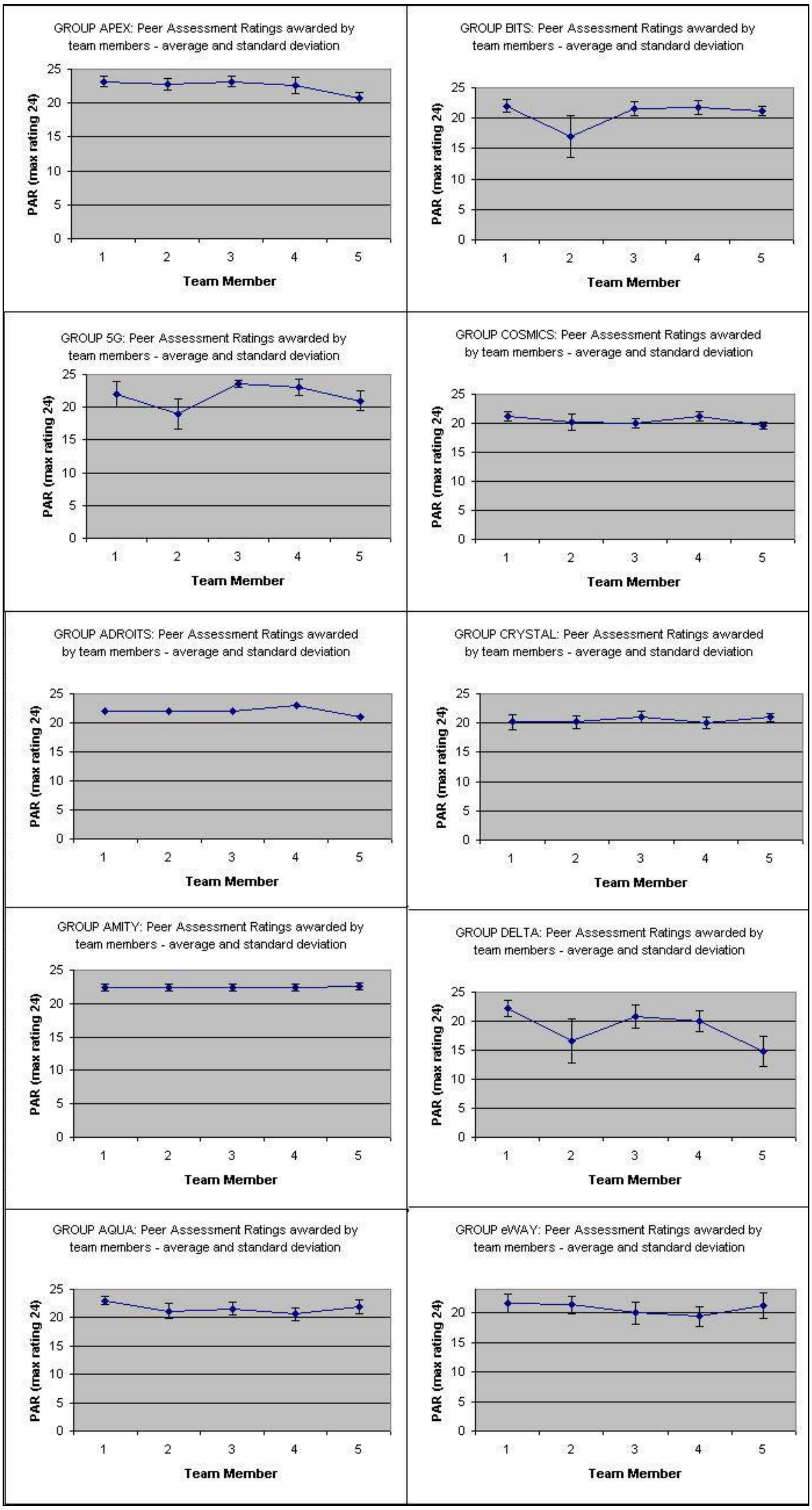


Figure 6.5: PAR awarded within student groups 1-10 for Assignment 2 (2006)
(NOTE: Error bars on graph show standard deviation of scores awarded across the team)

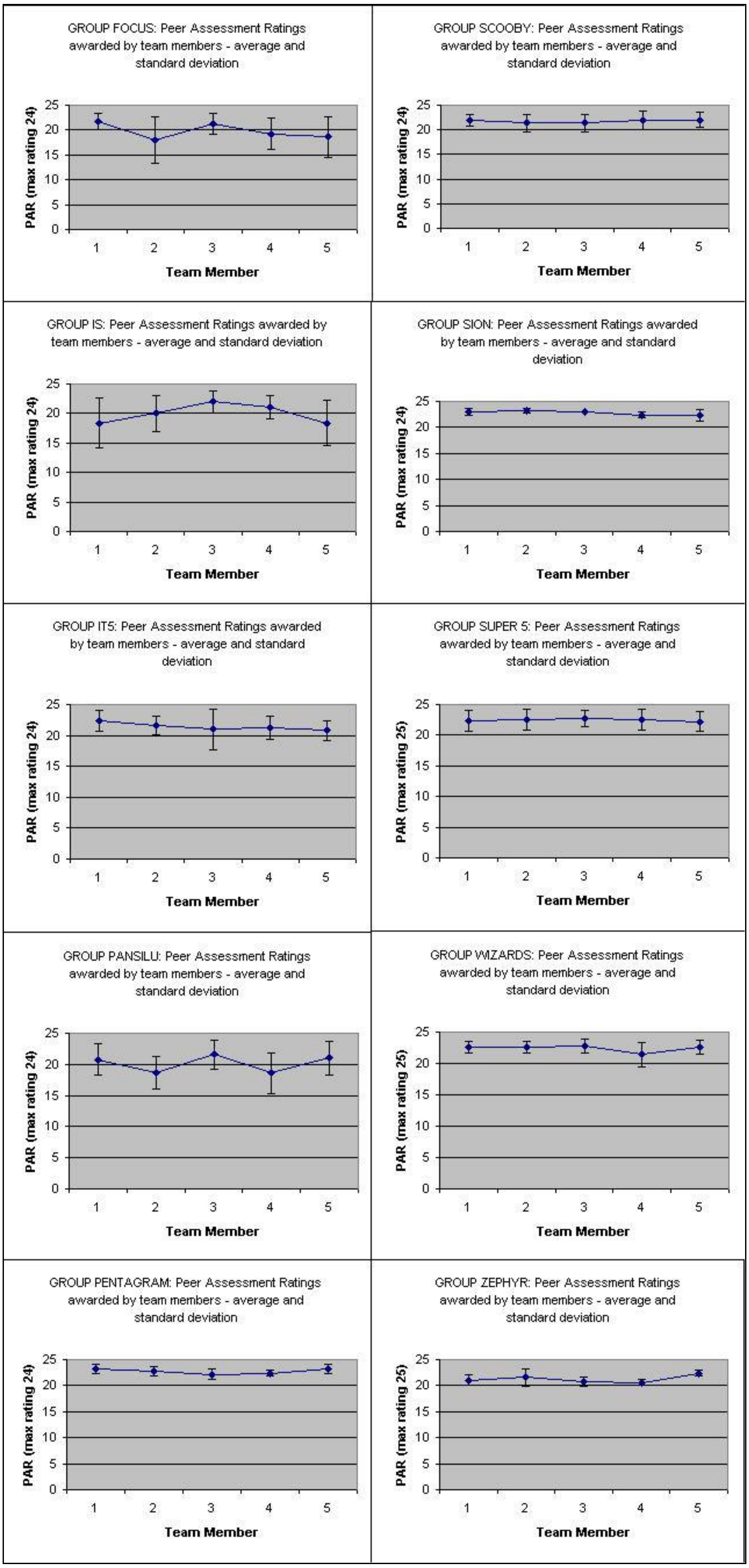


Figure 6.6: PAR awarded within student groups 11-20 for Assignment 2 (2006)
(NOTE: Error bars on graph show standard deviation of scores awarded across the team)

are represented as error bars. In cases where the same or almost the same PAR was awarded to all team members, error bars may appear to be non-existent. In almost all cases, error bars are small indicating a very limited spread of marks.

Presenting the 2006 group with a detailed description of the rubric for calculating team and individual results to counter claims made in 2005 that they did not know how or if PAR would be used, did not appear to have any impact on students who continued to claim in focus groups that the calculation of group and individual grades was not transparent.

Viva Voce or oral examinations were introduced in 2006 in an effort to increase the sense of individual accountability beyond what had been achieved using PAR previously. Following their group presentation for their final assignment, students were required to individually answer questions about the team product. Unfortunately, the only evidence of team collaboration in the *viva voce* was the coaching of fellow team members and friends behind the scenes to answer *viva* questions. During the *viva*, many students gave prepared (memorized) answers that were only tangentially related to the question being asked but which aptly answered questions asked of previous examinees.

6.2.4 Problem Solving skills

Focus group participants in 2006 confessed to rampant plagiarism. Wherever possible, assignments were completed by copying material from the Internet or from the work of senior students. Workload pressure was cited as the main reason.

However, assignments that required students to apply their knowledge and which could not be done by copying, were well regarded as this comment illustrates:

> Before this project there was another one and we didn't have any knowledge of it. There are some things that we didn't know at all that we know now. This project is also such a task and we would definitely learn something from it. But, if we were given a task we would try our best to complete it. In order to learn some thing we should get projects like this. It is then we would get a chance to implement our theoretical knowledge on a practical level. This is the best method of learning. Otherwise we'll only know the theory.
>
> (Participant, Focus Group 2006)

Students were also eager to learn practical skills which they felt would be useful to them after graduation and appreciated having the opportunity to do so through the Software Engineering assignments particularly as they were anxious that the BSc course was not otherwise providing them with the skills and knowledge they felt they would need in industry. When asked what sort of work they would be looking for after graduation, one-third of the students who responded to the question said that they had no idea and/or felt uncertain or concerned about their future job prospects.

> I want to be a good IT professional. But after coming to the faculty a fear came to our mind whether we will be able to work well in the industry because after finishing more than a year we feel that we haven't got any knowledge that will help us to work in the industry.
>
> (Respondent, Course Experience Questionnaire 2006)

> Still I haven't any idea about this degree and what they are going to do with us. No idea to do after going to the Industry. I am in very uncomfortable manner when thinking about the training and also going to the job field. I am very, very scared for that. I think I will not get a job.
>
> (Respondent, Course Experience Questionnaire 2006)

This anxiety about gaining appropriate skills and knowledge was probably expressed most dramatically in an incident where most of the cohort resorted to paying for private sector classes outside the university because they felt that they had not gained enough practical skills in a Java programming subject. This rather expensive exercise did not even help their Java assessment results as it was done after the examination.

Unfortunately, the final assignment of the Software Engineering course which required students to produce a Systems Requirement Specification (SRS) for a real world client was not perceived by students as meeting their needs for industry-relevant experience as they claimed to be unclear about what was expected in the assignment and to have insufficient knowledge to complete it. This contrasted with the experience in 2005 where students claimed to have gained a practical understanding from tasks firmly situated in the real world such as the assignment requiring them to produce a SRS for the Academy of Design. Many of the team assignments in 2006 were done by individuals or teams of two or three people with most work showing evidence of rampant plagiarism. Some students had even gone so far as to copy diagrams from the work of other teams.

> Moderator: Tell me how you did [the assignment]?
>
> Participant: Now in my group only 2 people worked. We took the template and gave a person who knows how to learn something and he did it and we gave it.
>
> Moderator: What did the others do?
>
> Participant: Nothing. If the others were called it would not have helped as no one understands.
>
> (Focus Group 2006)

Cammish (1997) noted a similar tendency to plagiarise amongst international students at British universities and put this down to a lack of confidence in their use of English in formal written assignments. This may well have been part of the problem but the feeling of uncertainty with regard to what was required in the assignment was undoubtedly also an important contributor. Continuous assessment results plummeted from an average of 78% in the previous year to an average of 69% in 2006. Asked to rate their learning experiences throughout the semester from “1 - most useful” to “10 - least useful”, students rated doing the course assignments fourth after self-study, participating in *kuppi* and working with their team (Fig. 6.7).

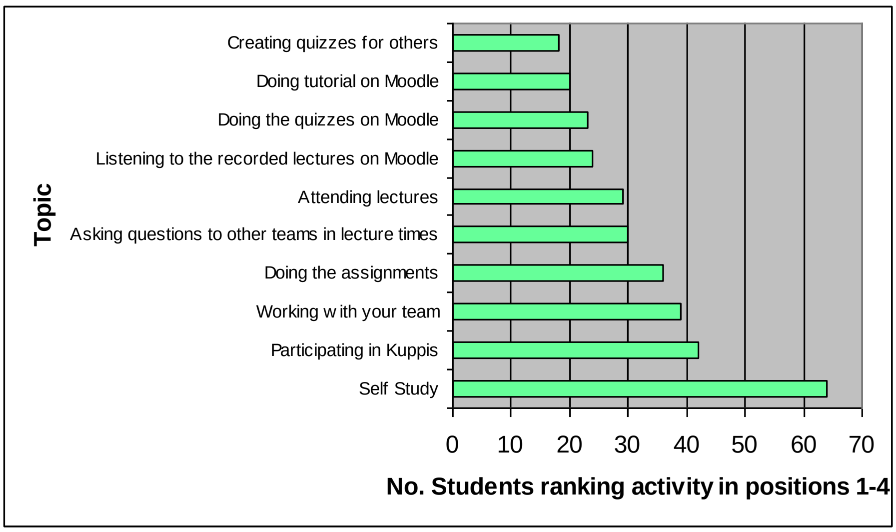


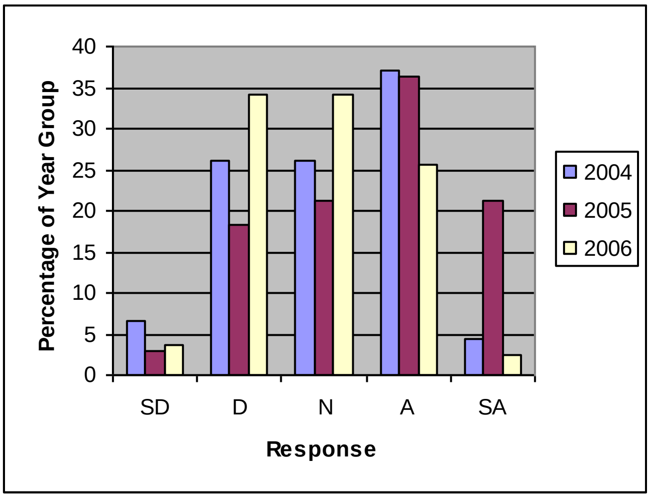
Figure 6.7: Perceived usefulness of learning activities experienced in 2006
Note: Students were asked to rank activities from 1 (most useful) to 10 (least useful). This graphic depicts the number of students who ranked each activity above the mid-point (5).

Answering a similar question in 2005, around a third[80] of the students nominated course assignments as the most useful activity they had done in the course.

As Internet access was problematic even by the time that students needed to be working on the final assignment, SRS templates were provided for them to be read and/or downloaded from the (local) Moodle site. By contrast, students in 2005 had been expected to find appropriate templates for themselves by searching the Internet. Nonetheless the 2006 group felt that they had not been provided with enough lecturer support.

> If you can give us more ideas about our assignments it'll be helpful e.g. we done the SRS but we didn't know what it is when we were writing it. What we did was, going through the template and describe the things there.
>
> (Respondent, Course Experience Questionnaire 2006)

Two obvious differences in the learning environment for the 2005 and 2006 groups were the presence of team facilitators in 2005 and the perceived lack of Power Distance (refer to Chapter 5) between the 2005 group and their lecturer/facilitators. Lecturers also felt that the average ability level of students in 2006 was lower than that of the 2005 year group (Weerasooriya, U. 2005, pers. comm. 25th October). They attributed this to enrolments having doubled, opening up the course to students with lower z-scores (the z-score is a statistical method used by the University Grants Commission to bring the marks of different subjects to a common and comparable standard which can then be aggregated and used for university selection).[81]



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 6.8: Comparison of 2004/2005/2006 student responses to the statement, "*Doing this subject has improved my problem-solving skills*".

Finally, although case studies had been introduced in tutorials to help build problem-solving skills in the lead-up to the final assignment, these failed in their intent. Rather than encouraging collaborative learning, allowing students to post their answers to an open discussion forum instead provided an opportunity for plagiarism which the majority of students took advantage of. As the content of the case studies did not directly relate to their lectures (and was therefore not examinable), students

[80] The question in 2005 was an open-ended question rather than requiring students to select from a set of alternatives and was not answered by all respondents. 13 out of 33 students who answered the question thought that building the team website (assignment 1) was the most useful activity they had done, 11 out of 33 mentioned doing the class presentation (assignment 2) and 9 out of 33 mentioned making the software requirements specification for a real business.

[81] University Grants Commission official web site http://www.ugc.ac.lk/

felt the case studies were irrelevant and took the most expedient path – in some cases just copying someone else's answer without even reading the case study itself. Unsurprisingly, very few students (28% of the group) felt that *Doing this subject has improved my problem-solving skills* compared to 58% of students in 2005 (Fig. 6.8), significant at the P=0.01 level.

6.2.5 Communication skills

Although the final assignment included a presentation component, students in 2006 did not feel that the course contributed to their communication skills as much as students in 2005. Some 45% of students agreed with the statement, *My spoken communication skills are better as the result of doing this subject* compared to 51.5% in 2005 (Table 6.1 and Fig. 6.9) and 55% agreed that, *Doing this subject has improved my skills in written communication* compared to 51.5% in 2005 (Table 6.1).

Moreover, while students might have felt that their communication skills were improving, comments made in focus group sessions revealed a fundamental paradox.

> Moderator: By doing these project assignments, how have your presentation skills changed?
>
> Participant: It has improved really well.
>
> Moderator: Is English a barrier when you present?
>
> Participant: Yes definitely.
>
> Moderator: So what steps did you-all[82] take to overcome that?
>
> Participant: We memorise the whole presentation. According to the time we memorise the facts.
>
> (Participant, Tamil-medium Focus Group 2006)

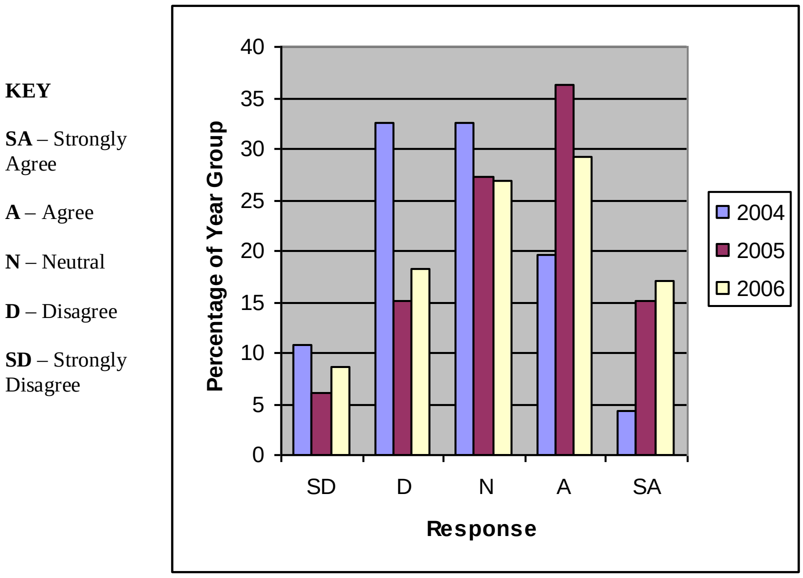


Figure 6.9: Comparison of 2004/2005/2006 responses to the statement, "*My spoken communication skills are better as a result of doing this subject*".

This is not unexpected as Cammish (1997) has already been cited in Chapter 3 recording similar tendencies amongst Asian students studying in UK universities to memorize answers for assessment situations where they were concerned that their English might not be up to the required standard.

[82] A common Sri Lankan expression meaning you (plural).

While students might have been happy to think that their presentation skills were improving, knowing that these would have to be mastered before entering the industry, ultimately these skills would be of little use to them without a firm grasp of English and, beyond that, a firm grasp of the language of Software Engineering. While student English language fluency was not assessed in 2006, their lecturers estimated that around one-third of FIT students had limited fluency in English (refer to Chapter 3). In the Course Experience Questionnaire presented in 2007, students were asked to respond to the statement, *Doing the course in English was difficult for me* resulting in 28.2% of the respondents agreeing with the statement whilst 18% indicating that they strongly agreed (Fig. 6.10). Given that they came from similar backgrounds and had similar first year experiences, there is no reason not to assume that the situation was the same for 2006 students.

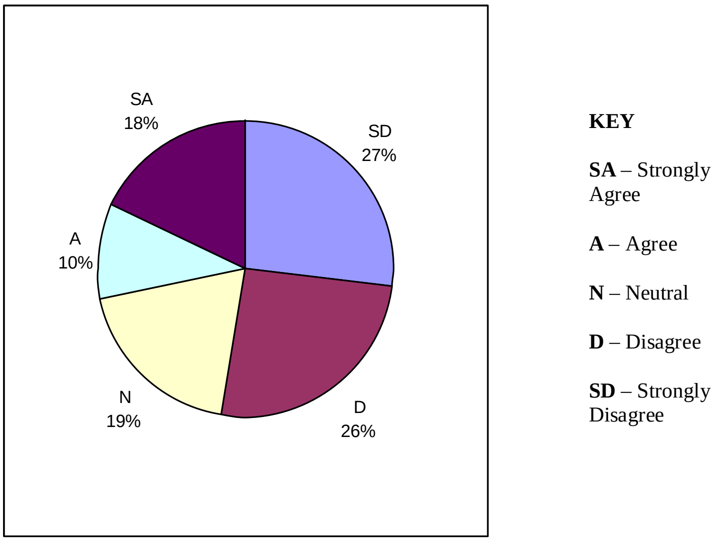


Figure 6.10: Student response (2007) to the statement, "*Doing the course in English was difficult for me*".

Further investigation of the issue in 2006 additionally revealed that the problem was particularly acute in terms of spoken English.

> We don't have any problem in writing we are not fluent in talking, so it is very hard to communicate with lectures and other fellow friends.
>
> (Participant, Tamil-medium Focus Group 2006)

While lack of confidence and ability in spoken English may have been particularly problematic for Tamil-speaking students, given that there was only one Tamil-speaking lecturer on staff in 2006 and hence limited opportunity for them to ask questions in their mother tongue, a lack of opportunity to practice English conversation affected the confidence of all students who were in any case anxious about embarrassing themselves through making mistakes in spoken English (refer to Chapter 3). Clearly, students needed to be put into situations where they are forced to speak in English such as happened in facilitated team meetings in 2005. Assignment presentations to the class were done in English and, as noted above, some focus group respondents reported using English in team meetings. Additionally one student in each group had the opportunity to speak English when meeting the industry client in preparation for Assignment 3. However, for others, almost the only opportunity they had to converse in English was in the end of semester *viva voce* or oral examination.

> Finally we had to face for viva about our presentation on the system which we are going to implement (SOCS). I think that is the best experience which I got from all this IT2104 group works. Because I think, this is the best way to improve communication skills. I was unable to speak in English with some one until this viva, so I was satisfied a lot about my speaking. I got very good experience through that viva.
>
> (Student Reflection 2006)

> Doing a viva is entirely a strange thing for me & I got very interesting experience through this. And the other thing is I have done the viva with our foreign lecturer Ms. Debra. Before I face to this I felt little bit afraid, because I thought I could not understand the things that she speaks. But I have done this very well & I answered all the questions she asked from me. This is really cool. I love it.
>
> (Student Reflection 2006)

Finally, whilst students might claim that their written English skills were better than their spoken English skills, those with poorer English often had either little opportunity to improve as team leaders discouraged them from contributing to team assignments or they, themselves, opted out.

> In my group you can't say that they all don't work. There is one person who doesn't work at all. If we have to make a document we would all divide the work and do it but the person who doesn't work is not fluent in English so it's difficult for this person to write documents and presentations.
>
> (Participant, Sinhala medium Focus Group 2006)

6.2.6 Independent learning skills

The perception of students in 2006 was that the learning environment within FIT was not one which encouraged students to take control over their own learning. In fact, the issues most frequently raised in focus groups such as the 80% attendance requirement,[83] lectures being cancelled or postponed without notice, assignments for multiple subjects falling due on the same date or on sequential days, and lectures being scheduled within the exam study week were all factors which they perceived as taking control away from them and contributed to their feeling that the faculty was not supportive.

> There are lecturers who don't teach properly. When students don't come for lectures, they will eventually realize that they have a weakness in their teaching methods. We are not small children to force us to go for a lecture. Most if us are 21+ and we are old enough to make our own decisions. If the lectures are useless, then we can utilize that time for something else. There should be an 80% attendance for lab sessions. Then we can find out whether we know our theory thoroughly. If we don't perform well at a lab session then we will realize that we are finding that section difficult because we missed the lectures. Then we will also be practically proficient.
>
> (Participant, Focus Group 2006)

Being forced to attend lectures which they felt provided a poor understanding of the subject only added to the feeling of discontent. Software Engineering lectures were included in this category being regarded as purely theoretical.

> Moderator: How could one improve this Software Engineering course?
>
> Participant 1: If the lecturing was more productive then it will be better.
>
> Participant 2: The only thing is the lecturing has to improve.
>
> Participant 3: For a long time after starting the course we didn't understand what Software Engineering actually was.

[83] Students had to attend 80% of their lectures for any given subject in order to be eligible to sit for the exam. This was a university regulation but was not enforced in other faculties. It was enforced in FIT because the Dean and senior staff had concerns about whether students would be able to deal with the responsibility of taking control for their own learning given that their educational background had not prepared them for it (A. Madurapperuma 2006, pers. comm., 25 July).

Participant 4:   It was just theory based studies.

(Participants, Focus Group 2006)

Students stated that they expected lecturers to help them by providing notes which were more readable than the text book, by illustrating theory through practical examples, and by sharing with them their knowledge and experience of the industry. Many positive comments were made by focus group participants about lecturers who were able to do this. However, speaking from the background of industry experience was somewhat difficult for many of the lecturers who had taken up academic positions immediately after gaining their own degrees (all but two of the lecturing staff in 2006 had followed this path). The faculty tried to address this problem by inviting guest lecturers from local software development houses even though this often proved to be an administrative burden.[84] Only 30.5% of students in 2006 agreed with the statement, *After doing this subject, I feel that I understand how software engineering is used in the IT industry* compared to 57.6% in 2005 and 56.5% in the baseline study (Fig. 6.11).

KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

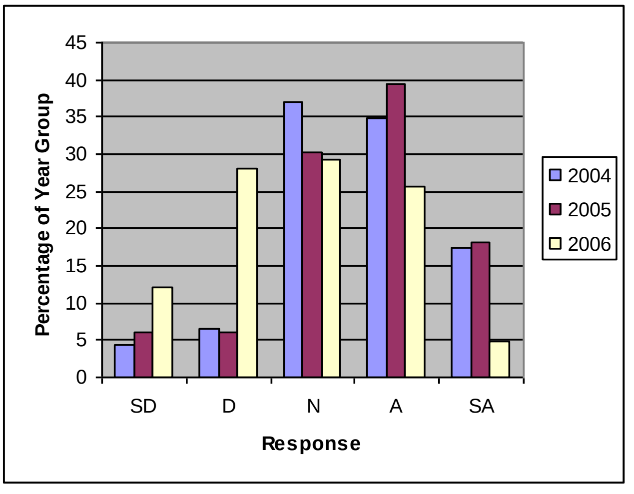


Figure 6.11: Comparison of 2004/2005/2006 student responses to the statement, "*After doing this subject, I feel that I understand how software engineering is used in the IT industry*".

While this response can be partially attributed to a lack of industry grounding to lectures, it must be remembered that the level of industry experience of lecturers was no less in 2006 than it was in 2004 and 2005. The degree of negativity in the response is probably best interpreted in the light of general student anxiety, described above, about their professional preparation for industry.

Lack of time was the primary factor perceived by students as reducing their control over their own learning as 15 out of 21 student team reflections made mention of time pressures (variously attributed to faculty extra-curricular commitments, excessive academic workload or poor individual time management) constraining the quality of their assignment work. Students also claimed that they did not have sufficient time to access Moodle resources for self-study and this was reflected in Moodle statistics for quiz access which showed 2006 student usage of quizzes to be well below that of 2005 students (Fig. 6.12). Bearing in mind that the 2005 statistics

[84] With only minimal salary incentives on offer, most people who offered themselves as guest lecturers, did so out of a sense of social service. When faced with pressures at the work place, there was a tendency for these people to cancel their lectures leaving the faculty in the position of having to substitute one of their permanent staff or cancel the lecture (Dias, D. 2007, pers. comm., 29 November).

were collected just prior to the end-of-semester examination whereas the last 2006 statistics were collected some three weeks before the end of semester immediately prior to the server crash, I also compared 2006 results with 2005 data (adjusted based on the relative proportions of quizzes attempted during the semester compared with quizzes attempted during the reading week). A third series of data has been added to the graph in Figure 6.12 showing this. These adjusted statistics also show that 2006 students had less enthusiasm for using these online tools than their counterparts in 2005 except at the very beginning of the semester.

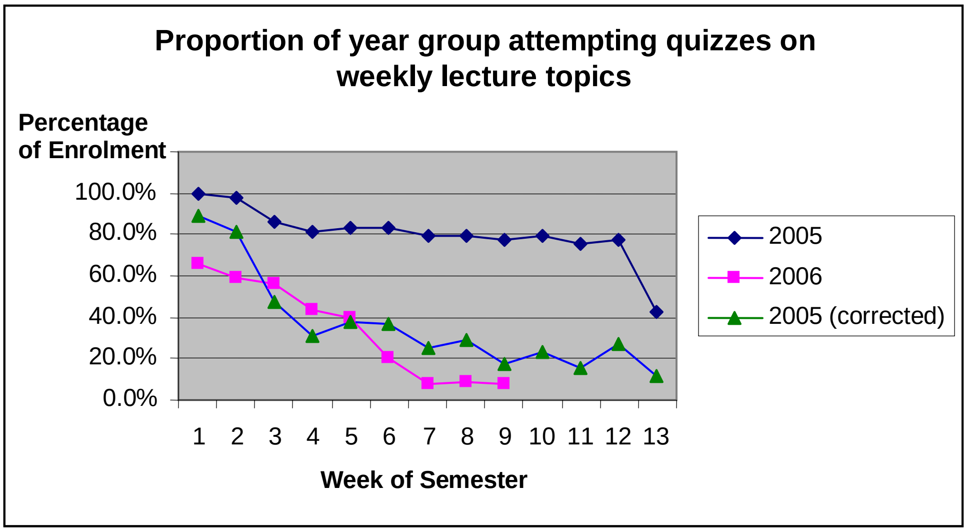


Figure 6.12: Comparison of numbers of students attempting quizzes in 2006 and 2005.
Note: 2005 numbers also shown adjusted for attempts made during the semester versus at the end of the semester.

A repeated complaint made by students in 2006 was that they were reluctant to use the audio lectures recorded using Articulate Presenter™ since these had to be played from start to finish without the facility of navigating to a particular slide and were thus very time consuming to use. Lack of computing resources was also frequently mentioned as a problem.

Finally, students were critical of the lack of feedback for assignments and exams and suspicious of grading systems which they regarded as lacking in transparency. While FIT has a policy of returning grades to students within 2 weeks of assignment due dates, the amount of feedback given is at the discretion of the lecturer. In focus group sessions, students cited cases where what they believed to be excellent work was awarded poor grades because of perceived personality conflicts with lecturers while what they believed to be poor work (including their own), received excellent grades. They claimed that the resultant lack of transparency left them with little sense of control of their own learning.

> There is not enough transparency in the marking system, so most student think that if you go behind a lecture[85] then they could get an A+. The students don't know how the marks were given. If the lecturers mark the papers and return them to the student there will be a better understanding of the marking system and where we went wrong. We know that they can't release the final exam papers but at least if they give back the assignments it would be better.
>
> (Participant, Focus Group 2006)

[85] Sri Lankan expression meaning to seek favour with a lecturer.

Despite this, the average result in the end of semester examination for 2006 was 68% compared to 65.5% in 2005 and 48.6% in the baseline study perhaps indicating that student anxieties were unfounded.

As the result of their negative perception of the formal learning environment, students turned to each other for support through group study sessions and through the mechanism of the *Kuppiya*. Students from the same boarding house commonly studied together, pooling books and resource material and tutoring each other as necessary.

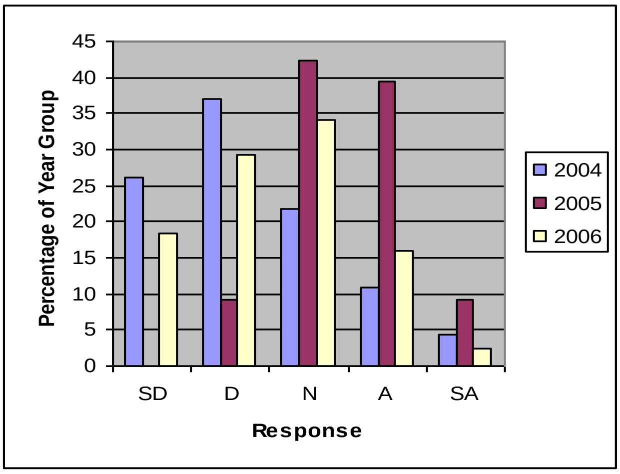
> They plan and say "OK let's study this section for one hour and after that discuss about it". No one can study everything at once. So we divide the sections and study individually and then discuss each section in a group.
>
> (Participant, Focus Group 2006)

Kuppi were as popular in 2006 as they had been in previous years. However, with the change in the syllabus, students were no longer able to call upon their seniors to conduct the *Kuppiya* and had to turn to each other. As a peer tutoring mechanism, the *Kuppiya* in such a context has considerable collaborative learning potential.

> Piagetian theory predicts that change in concepts is most likely to occur when assimilation[86] and accommodation are in balance. Such a balance is more likely to occur in cooperative situations characterized by mutual respect, rather than unilateral authority (O'Donnell 1999, p.37).

When learning from each other, students reported discussing concepts and theories rather than just listening to them as they did in lectures and they were able to tutor each other in words and using examples which were easy for fellow students to understand.

> We can get a better idea about the lesson when our friends explain. Some students can explain theory parts better than lecturers. I think the problem is the way our lecturers teach us.
>
> (Participant, Focus Group 2007)



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 6.13: Comparison of 2004/2005/2006 student responses to the statement "*I often made comments and asked questions in lectures*".

86 Assimilation happens when an object or event is brought into one or more cognitive system components in order to confer meaning. Accommodation involves a momentary modification of a cognitive system component in order to adjust to present circumstances. (O'Donnell, AM 1999, *Cognitive Perspectives on Peer Learning: Rutgers Invitational Symposium on Education Series*. Lawrence Erlbaum Associates Inc., Mahwah, NJ)

In direct contrast with the heavy reliance on interactive *Kuppi* in 2006, the numbers of students who agreed with the statement, *I often made comments and asked questions in lectures* dropped from 48.5% in 2005 to 18.3% in 2006 (Fig. 6.13), a difference significant at the P=0.001 level.

Unfortunately the evidence suggests that the full potential of such collaborative learning exercises for extending knowledge is not fully realized as *Kuppi* sometimes become rote learning sessions.

> Moderator : Do you do past papers?
>
> Participant 1 : Last time we did. Though we don't understand the meaning, we by-heart [rote learn] the thing and write. Some words are used for some particular subjects only…then we learn to use them accordingly.
>
> Participant 2 : Normally what we do is study the slides. Sometimes you get the same slide and when you write the exact thing only you get marks
>
> (Participants, Focus Group 2006)

As the latter comment reveals, this practice reflects a student belief that their lecturers want to see their own words reported back to them on exam papers, with 63% of students in 2006 agreed with the statement, *To do well in this subject, all you really need is a good memory* compared to 48.5% of students in 2005 (Fig. 6.14) although this difference was not statistically significant.

KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

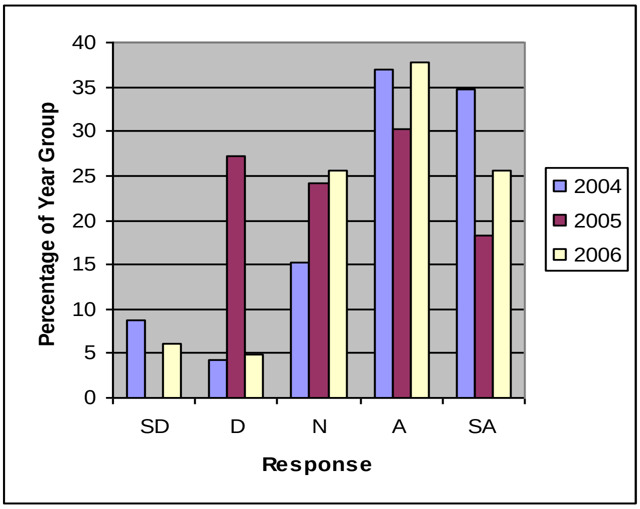


Figure 6.14: Comparison of 2004/2005/2006 student responses to the statement, "*To do well in this subject, all you really need is a good memory*".

Efforts to try to replicate the interactivity of the *Kuppi* in the lecture room, through exercises such as the inter-team quizzes, were partially successful although the format allowed less confident students to avoid using their English and the standard of questions asked was often shallow (typically calling for the definition of terms and concepts rather than requiring students to apply their knowledge). From student feedback, I concluded that students did not understand the concepts put to them in lectures sufficiently to ask questions beyond what they could structure based on the slide printouts they had been given. For the inter-team quizzes to achieve their desired objective (i.e. to cause students to interact meaningfully with the course content) students had to be comprehending the concepts of the lecture and thinking how to formulate questions based on them while the lecture was on-going. Nonetheless, the possibility of being asked a question in class did serve as a motivator to at least listen to the lecture.

Moderator : Did that [question and answer session] do any good to you?

Participant 1 : Yes, we were very attentive because they ask questions

Participant 2 : We were motivated better than other days.

Participant 3 : Yes that method is good but the person who answer and question is always a good student.

Moderator : But did you attempt to study? Because of that did you learn anything?

Participant 4 : Yes. That's correct it made us learn.

…

Participant 5 : Yes. Another thing is, in order to ask a question you should have the knowledge. If the answer is wrong the lecturer gives us the correct answer and that grabs everyone's attention. So the students would at least read the tute which I feel is really good. There should be some sort of commitment from us as well to get prepared by reading the tutes prior to the lecture. Since we prepare for it before hand, we could also discuss questions which arise during our preparations.

(Participants, Focus Group 2006)

6.3 Discussion

It would have to be said that the design of the course in 2006 was unsuccessful in achieving the goal stated at the conclusion of the previous chapter i.e. ensuring that more students were able to experience a successful learning environment. The experience of the "power of the team" described by some groups in 2005 proved elusive to most in 2006 whilst other aspects of the learning environment which had contributed to a successful experience of PBL in 2005 were unable to be replicated in 2006 due largely to the change of context.

Whilst unfortunate in terms of learning outcomes for the students concerned, this change of context and its impact provided some interesting insights into the primary research question of this thesis – namely, "How can a PBL approach be implemented effectively in [the context of] FIT to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills?". To illustrate by example, had it been feasible to provide teams with facilitators in 2006 as in 2005, this would have been done as the strategy appeared to have been successful. However, as various factors such as the non-availability of space for team meetings, the departure of the two original lecturer/facilitators and the increased enrolment, combined to make it very difficult to do this, it was necessary to make changes to the design to try to scaffold learning through other means. This, in turn, made it possible to compare and contrast the impact of providing facilitators with other strategies.

6.3.1 Implications of the results for teamwork

Levels of student motivation to achieve not only high marks for the course but also the knowledge and skills which they saw as beneficial for their professional careers, remained high as discussed earlier. They recognized teamwork, communication, problem-solving and independent learning as skills desired by employers. However, the course design for Software Engineering in 2006 did not provide them with the appropriate experience to develop many of these skills for a number of reasons. The pressure under which they perceived they were working made it difficult for team leaders to convene team meetings and, in the absence of alternative role models, students approached teamwork as an exercise in producing the best possible product through the pooled efforts of the most capable and/or hard-working individuals in the team (i.e. cooperative rather than collaborative group work). Discussion within groups was limited thus curtailing opportunities for collaborative learning. This contrasted with the experience of the same students in informal study groups and *Kuppi* which were, reportedly, far more interactive. It might be argued that where students thought they stood to gain more personally, they were more likely to participate. In 2006, this was more likely to be in study groups and in *Kuppi* rather than in formal team meetings, although the website development assignment attracted relatively high levels of participation. In 2005, students were more likely to view assignments as useful learning exercises helping to explain why participation levels were higher in that year and the level of social loafing less than the 2006 experience.

Having been used for two consecutive years without much success, peer assessment appeared to have only limited value in addressing the issue of social loafing. Oral examinations or *viva voce* were also less effective than had been anticipated with English fluency issues making it difficult to make an accurate assessment of the true level of student knowledge. From the evidence of social loafing found in student reflections (described above), it would appear that freeloading was an even more acute problem in 2006 than in 2005 despite the use of both PA and *viva voce* to discourage it. Two possible causes were the level of pressure that students were working under and the model of teamwork adopted. Students in 2005, working under less perceived pressure and with more of a sense of team identity, experienced less freeloading in teams.

Lecturer selection of team membership unintentionally contributed to the poor teamwork environment by putting together people who did not effectively have a common language and who did not commonly meet up outside lectures. As Stacey (2005, p.156) notes, ‘A shared means of communication is essential so that learners are able to argue or share ideas and work collaboratively together and make collaborative learning a meaningful learning process’. The social distance between team members also worked against ensuring that ‘all members of a cooperative learning team feel a sense of responsibility for their teammates’ – a requisite for a successful team experience posited by Cooper, Robinson and McKinney (cited in Speck 2003, p.62). Membership of some teams was also disadvantageous to female students. Student feedback provided a number of good arguments in favour of team self-selection. Given that the benefits anticipated from lecturer structured teams of encouraging students to practice their English language skills, to work collaboratively with students from other ethnic backgrounds, and to participate in peer tutoring, were not realized in the absence of an effective linking language, it was decided to allow self-selection of teams in 2007.

6.3.2 Implications of the English Language Issue

Lack of English language skills, particularly spoken English, emerged as a significant problem – not only in teamwork but in learning in general. Student coping mechanisms such as rote learning answers for exams or memorizing presentations were counterproductive to achieving the desired learning environment. If a student’s contribution to the presentation of his/her team’s product was limited to memorizing a piece prepared by another student(s), it is unlikely that that the presentation exercise was challenging him/her to understand the work. Similarly, rote learning of answers for exams was unlikely to help students assimilate the concepts of the subject.

The problem did not appear to be one of insufficient motivation. While there have been some instances of students agitating for a shift in the medium of instruction from English to Sinhala (refer to Chapter 3), most FIT students recognise the importance of English language fluency to their future career prospects. Focus group participants from the first intervention (2005) were asked to nominate how important they thought each of a list of seven skills would be to potential employers. The skills included ability to rote learn or memorize content, ability to solve problems, good written communication skills, good oral communication skills, good English skills, ability to work well in a team, and knowing how to study effectively. Good English skills (average rating of 19%) were rated third in importance after teamwork (average 25%) and problem solving (average 24%) skills. A lead-in question to the exercise described above prompted the following response:

> *Moderator:* Normally if someone is applying for an IT career, what skills must they possess?
>
> *Participant*: The most important is having a good personality. When continuing an IT job, we need English knowledge, fluency… The job market has good opportunities for English speaking persons.
>
> (Participant, Focus Group 2006)

Sri Lankan students are not alone in facing the challenges of learning in a language that is not their primary language. Students in bilingual or multilingual classrooms all over the world face similar challenges with varying levels of support from their institutions. As noted in Chapter 3, first year students at FIT usually undertake a three month English course prior to embarking on their first year studies and subsequently enrol in IT1002 (Communication Skills Development) in their first year. These are, of necessity, general courses and do not address the issue of technical communicative competence or what is referred to by Coelho (2004) as CALP (Cognitive Academic Language Proficiency).

From the stance of situated learning, technical communicative competence is most effectively developed within the context to which it is relevant rather than in standalone courses. Coelho (2004, p.224), in *A Guide to Teaching in Multilingual Classrooms* states, ‘Words that are important to understanding a specific concept or lesson are best taught in the academic context in which they occur’.

There would appear to be little support for this view amongst FIT academic staff who, in interviews, expressed the view that English language development was the responsibility of the university English Language Teaching Unit (ELTU) or something that could be left to experience.

> Interviewer: Are they getting specific training in how to communicate or are they getting this by experience only?
>
> Lecturer: Not at the moment because, in our university also, we have just a single English department [ELTU]. So there also we find very few people. So they are the people who are normally responsible for doing this things related to language study and communication skills. So far we have outsourced this but this time we are going to give them a chance but they are having very few people so this is one of the difficulties that we have. Now, in our university, if we could make a different department for each faculty for this language study or communication skills, this might solve the problem. Because this is a major requirement for our course.
>
> (Senior Lecturer, Academic Staff Interview 2005)
>
> Interviewer: So do you do anything in your classes to help them develop these [communication and teamwork] skills?
>
> Lecturer: Actually in my class I’m not really concentrating on these things but certain things they have to present so they develop their presentation skills and most of the

> time I interview them so, like a viva kind of thing, to make sure whether they have really done the work and whether they understand it – that kind of thing.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Nonetheless, it was resolved within Software Engineering to integrate building students' technical vocabularies with building their understanding of the course content. The primary tool for doing this was the use of the Moodle Glossary module (an online dictionary) linked to the Moodle lessons (online course notes) and the use of audio recordings of the lecture built into the online lecture notes. These tools are discussed in more detail later in this chapter. Beyond this, it was the task of the lecturer to model the use of technical terms in lectures. To allow students to repeat the voiceover for a particular slide or to move back and forth between slides, the use of Articulate Presenter™ to produce Flash™ presentations with integrated narration was discontinued in 2007 in favour of compressed audio (.mp3) files embedded in individual slides using Microsoft PowerPoint 2002™.

Adler (2001) argues that there are a number of steps to developing CALP for multilingual learners and that prior to working on an understanding of technical terms, it is essential for students to have the opportunity to discuss the underlying concepts in their mother tongue. Code-switching is seen as an important tool to support this.

6.3.2.1 Failure to facilitate code-switching

Adler (2001) working in South Africa where the language of instruction is also English but where the students in any given class might have three or four different mother tongues, noted that code-switching, or the ability to move back and forth from the language of instruction to the student's mother tongue, is an important resource in the multilingual classroom. This is especially the case where it is used for exploratory talk – a term she uses to refer to the informal conversation between students and sometimes between a teacher and a group of students to discuss work, share ideas and shape each other's understanding of concepts. Adler claims exploratory talk in the mother tongue to be 'a necessary part of talking to learn because learners need to feel at ease when they are exploring ideas' (Adler 2001, p.72).

In retrospect, it appeared that we had denied our students in the first two years of this study, opportunities for effective exploratory talk by purposefully selecting team membership to include representatives of different ethnic groups who did not share a common mother tongue. While the way in which teams were selected gave some students an opportunity to practice their spoken English, as it was intended to do, the selection of team membership to include an ethnic and gender mix reduced opportunities for truly constructivist negotiation of understanding in teams since English language fluency was problematic for Sinhalese, Tamil and Muslim students alike. Valdes (cited in Baker 2001, p.195) working with groups of students learning in English where this was their second language, found that 'students understood too little English to move to higher order thinking despite having the cognitive capacity'. It is likely that this was also the case in the current study although the level of social loafing in 2006 also mitigated against opportunities for exploratory talk.

O'Donnell (1999) claims that the quality of peer interactions is critical in determining whether deep learning actually takes place.

> Task-relevant peer engagement characterized by questioning, explanations and predictions leads to perturbations that in turn lead to modifications of cognitive systems (O'Donnell 1999, p.37).

Given the extent of the English language problem for FIT students it seems likely that expecting students to work in English (and constructing teams so that there was no other common language) may have limited their capacity to discuss the topic of the assignment deeply and to move beyond superficial learning. Khoo (2003) noted a similar response reported from a medical school in Malaysia which had been trialling PBL approaches:

> A majority of the students agreed that PBL tutorials had encouraged them to seek information and improved their understanding, integration and application of knowledge. However, they still had difficulty in getting involved in discussion as the PBL sessions were conducted in English, which was a second language for many of them (Khoo 2003, p.406).

Accordingly, and for the anticipated teamwork gains discussed above, it was decided to allow students in 2007 to self-select their team membership. Self-selected teams were likely to be largely monolingual allowing lecturers to be able to code-switch, using Sinhala or Tamil where appropriate to talk to students in small groups while reserving English for lectures. Teams would continue to comprise five students. Since the lecturers and instructors involved in the course in 2007[87] were all Sinhala speakers, it was necessary to use English exclusively in lectures and when addressing the class as a whole in tutorials. Were this not done, there would be a danger of code-switching shutting out Tamil-speaking members of the student group who were not fluent in Sinhala.

Adler (2001) in South Africa, highlighted the dilemma for teachers of allowing code-switching in order to increase understanding of the subject content or insisting on the use of the language of instruction to maximise exposure to that language. This dilemma is as critical in Sri Lanka as it is in South Africa and for much the same reasons – all examinations are in English and fluency in English is essential to win the best jobs. She concluded that the issue is complex since the challenge is to support students as they move from informal spoken language in their mother tongue to informal spoken language in English and from there to formal spoken and written English using the terminology of the subject area accurately or, as she puts it, from ‘talking to learn to learning to talk’ (Adler 2001, p.72). Maximizing exposure to the language before students have learned to talk the language of their field of study may help their English language fluency at the expense of their technical understanding.

6.3.2.2 Failure to build CALP

Learning to talk the language of Software Engineering is essential for the young professional regardless of their level of fluency in English. Technical terms abound in the field of Software Engineering and many English words have a particular meaning when used in this context. For example, the architecture of a computer system refers to the manner in which software processes are distributed over the servers and workstations available – not the physical structure of the system.

However, the difficulty of comprehending the theory of Software Engineering and coming to grips with these terms for someone not entirely fluent in English is

[87] The Tamil-speaking lecturer/facilitator had departed after the first year to do further study in the UK. The only other Tamil speaking lecturer on the faculty staff, a tri-lingual Muslim, was a senior academic and not available to help in the course.

expressed best by a student (already quoted in a previous chapter) who explained how difficult it was to understand course resources such as the textbook:

> But software engineering is not easy for us to learn alone. We don't know anything. We don't understand what we read.
>
> (Participant, Focus Group 2005)

Adler (2001) puts the case that it is the responsibility of the teacher to model the language of discourse in the subject area, to mediate the meaning and to guide students in its proper use. The teacher should also support his/her students to make the journey described above from talking to learn to learning to talk (Adler 2001). This is a journey that must be taken in stages and cannot be short-circuited. Students learning in a second language need to be supported to use the language of instruction, firstly informally and then formally, to talk about the content.

Unfortunately the evidence suggests that most of the students participating in this study in 2006 never completed the journey to communicative competence in Software Engineering. They did not have an opportunity for informal exploratory talk within their teams because most teams did not share a common mother tongue and, because few of them interacted with the lecturer in lectures, they also did not have an opportunity to interact informally in English. It might have been expected that Kuppi would have provided students with opportunities for exploratory talk in their mother tongue. However Kuppi are normally conducted only at the end of semester in preparation for exams and so were of little use in understanding the lectures during the semester. The net result was that the formal and technical English of the Software Engineering lectures students sat through during the semester remained largely incomprehensible to many. They were presented with PowerPoint presentations prepared by the author of their textbook which were content-heavy, highly conceptual and used a standard of English appropriate to native speakers at a tertiary level (Fig. 6.15).

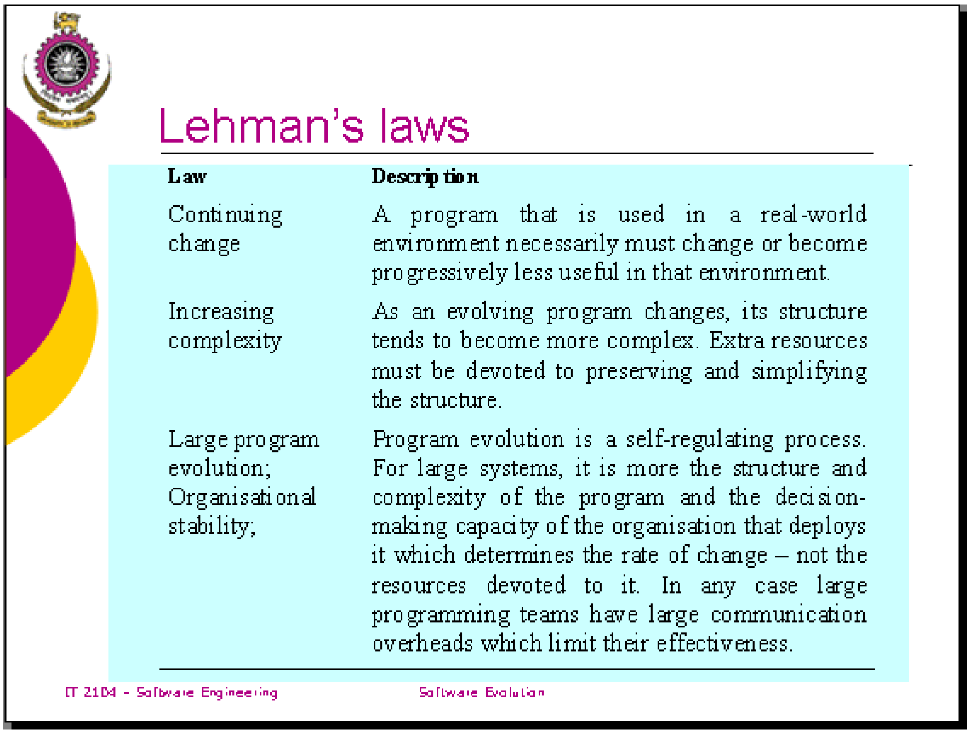


Figure 6.15: Example of a slide from the Software Evolution lecture

Unsurprisingly, students in 2006 rated their lectures one of the least useful learning experience of the Software Engineering course (Fig. 6.7). The 82 students completing the Course Experience Questionnaire in 2006, gave lectures a mean rating of 6.39 out of 10 with 1 being “most useful” and 10 “least useful”. In contrast to this, self-study received a rating of 2.69 clearly indicating that students thought they would have been better off to have studied by themselves. Unfortunately students were not asked to rate the textbook – an oversight of the study. The expectation that lecturers should be able to make subject knowledge more accessible by providing notes, meaningful examples and industry insights was not realised in Software Engineering lectures although, as noted above, students appreciated the industry relevance and practical nature of their tutorial activities and assignments.

6.4 Design for Phase III (2007)

Responding to students’ perceptions of the limitations of the course in 2006 and their poor coursework results, significant changes were made to the design of the intervention for 2007. These included changing the basis for forming teams and several changes designed to present the course in simpler English while at the same time building CALP through providing students with a glossary of technical and non-technical terms. It appeared to me that these aspects of the learning environment had hitherto acted as limitations on the ability of students to engage successfully in PBL.

The first change to be made was to allow students to self-select team membership in 2007. This was a fundamental departure from earlier instances of the design. As already stated, the main benefit expected from self-selection was the opportunity it would provide students for exploratory talk in their mother tongue. However, it was also anticipated that levels of freeloading would drop with students feeling a greater sense of responsibility within friendship networks and that collaborative learning would be enhanced by working with friends and in the same language.

Bearing in mind student anxieties about their future entry into industry, their perception that Software Engineering lectures gave them few insights into the professional reality of software engineering and the limited industry experience of the lecturer, it was decided to make a major push in this final year of the design to provide students with insights into industry through other means. A series of videos was made with representatives of leading software development houses in Colombo explaining the relevance of each of the topics covered in the Software Engineering syllabus to their own core business.[88] In the interests of building CALP, any technical terms used by the speakers were highlighted in subtitles and included in the Moodle Glossary. It was anticipated that these videos would provide some of the practical grounding for the concepts of Software Engineering that students claimed was missing from the course, while at the same time bringing them closer to industry and reinforcing for them the value of the theory and terminology that they were being asked to master. The videos were shown in lectures and students were given short follow-up quizzes on the content.

One approach to instructing students in a second language is Sheltered English, Sheltered Content Instruction or SDAIE (Specially Designed Academic Instruction in English), where minority language students are taught the curriculum with a simplified English vocabulary using purpose-made materials and methods. Content

[88] Each business was encouraged to select a different topic so that each video was relevant to one or, at most, two topic areas.

and curriculum materials are developed and pitched to match the English proficiency of the students (Baker 2001). Following this approach, the Lesson module in Moodle was used to make what effectively became a substitute textbook for the course. Lesson modules include quiz questions after each online “page” of content to allow the reader to check his/her comprehension. An example of a lesson showing text and end-of-page quizzes is included in Appendix F. Each Moodle lesson was checked for comprehensibility by the lecturer and with one or two students with average English fluency before being put online. Both technical words, and non-technical but relatively uncommon words, were linked to the glossary.[89] A discussion forum was also introduced to the Moodle site where students could request additional words to be added to the glossary. Following Coelho’s (2004) guide to teaching in multilingual classrooms, end-of-page quiz questions designed to give students a chance to practice new vocabulary acquired in the module were included in addition to standard technical questions. Moodle glossary entries included a definition and a usage guide as well as an audio file which demonstrated pronunciation of the word or phrase. This latter was intended to overcome any reluctance to use the word that might have stemmed from an ignorance of how to pronounce it. Snapshots from a lesson module and glossary page are shown in Figures 6.16, 6.17 and 6.18 below.

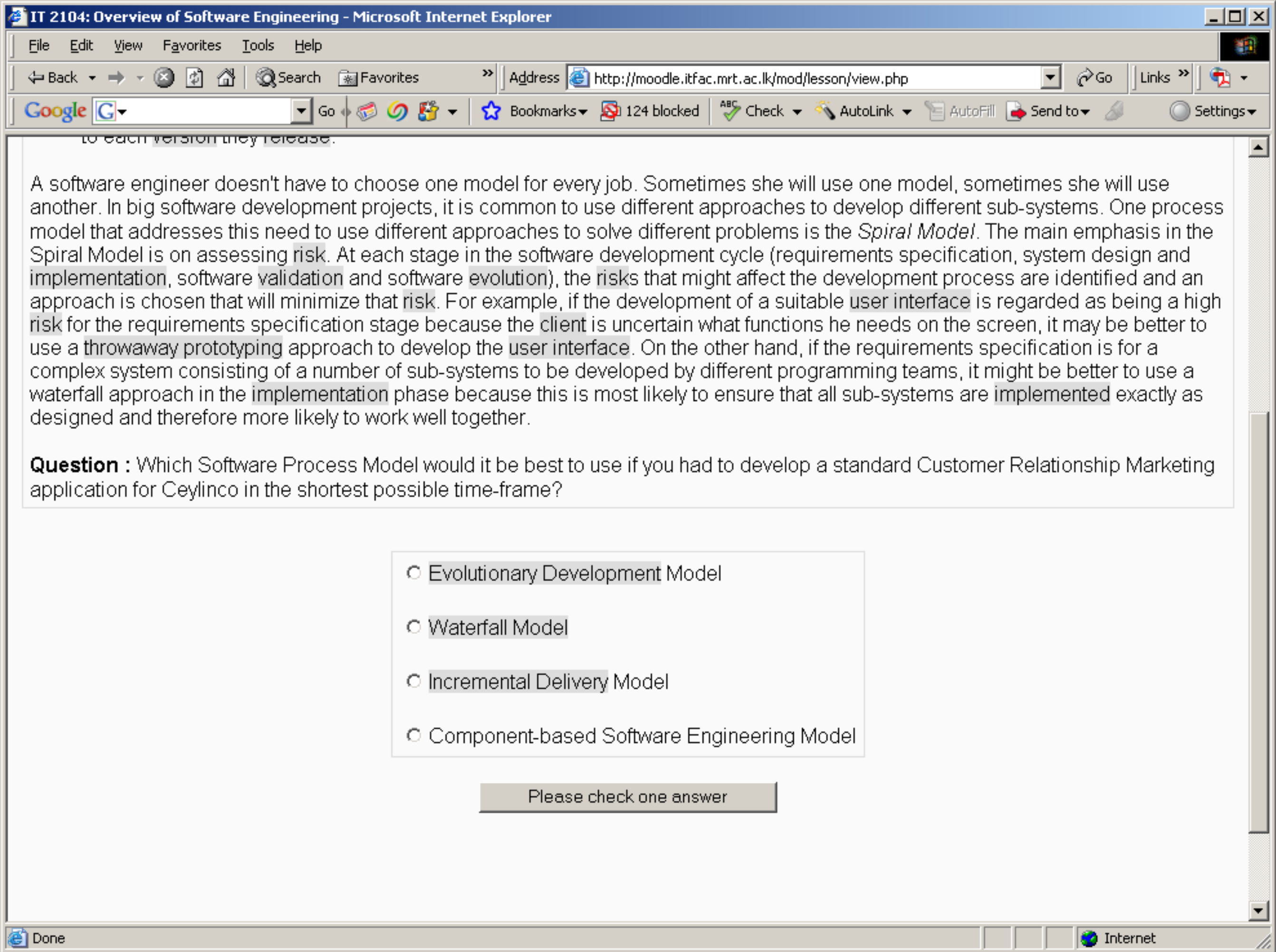
The usual multiple choice self-rating quizzes, built using the standard Moodle™ quiz module, were also provided for each section of the course. As well as greater emphasis on the correct use of the terminology of software engineering, quiz questions aimed, where possible, to measure student ability to apply the concepts of the lessons. As this made questions more complex, more extensive use was made of the feedback facility in Moodle quizzes to explain to those taking the quiz why an answer was considered correct or incorrect. Students were warned that their exam questions would be similar to these quiz questions but the quizzes themselves were not graded.

In addition to this, students were able to playback compressed audio (.mp3) files embedded in Microsoft PowerPoint 2002™ slides of their lecture notes so that they could hear the lecture as well as review the notes. This was intended to give students weak in spoken English the ability to listen to the lecture at their own pace and as many times as necessary. By providing them with a version of the lecture they could control, it was hoped to provide a solution to the problems of this student, and others like him/her, who said:

> The lecturing speed is big problem for us; we can’t understand what they are lecturing.
>
> (Participant Focus Group 2006)

Students were asked to review the lesson modules online each week before coming to the lecture. Baker (2001, p.362) suggests that, ‘When new words and new concepts are being introduced into a lesson, the teacher may spend some time in introducing the words and clarifying the concepts so that the language learner is prepared’. By reviewing the lessons before the lecture, students would be able to come to terms with difficult words which might otherwise stand in the way of their comprehending the concept being explained.

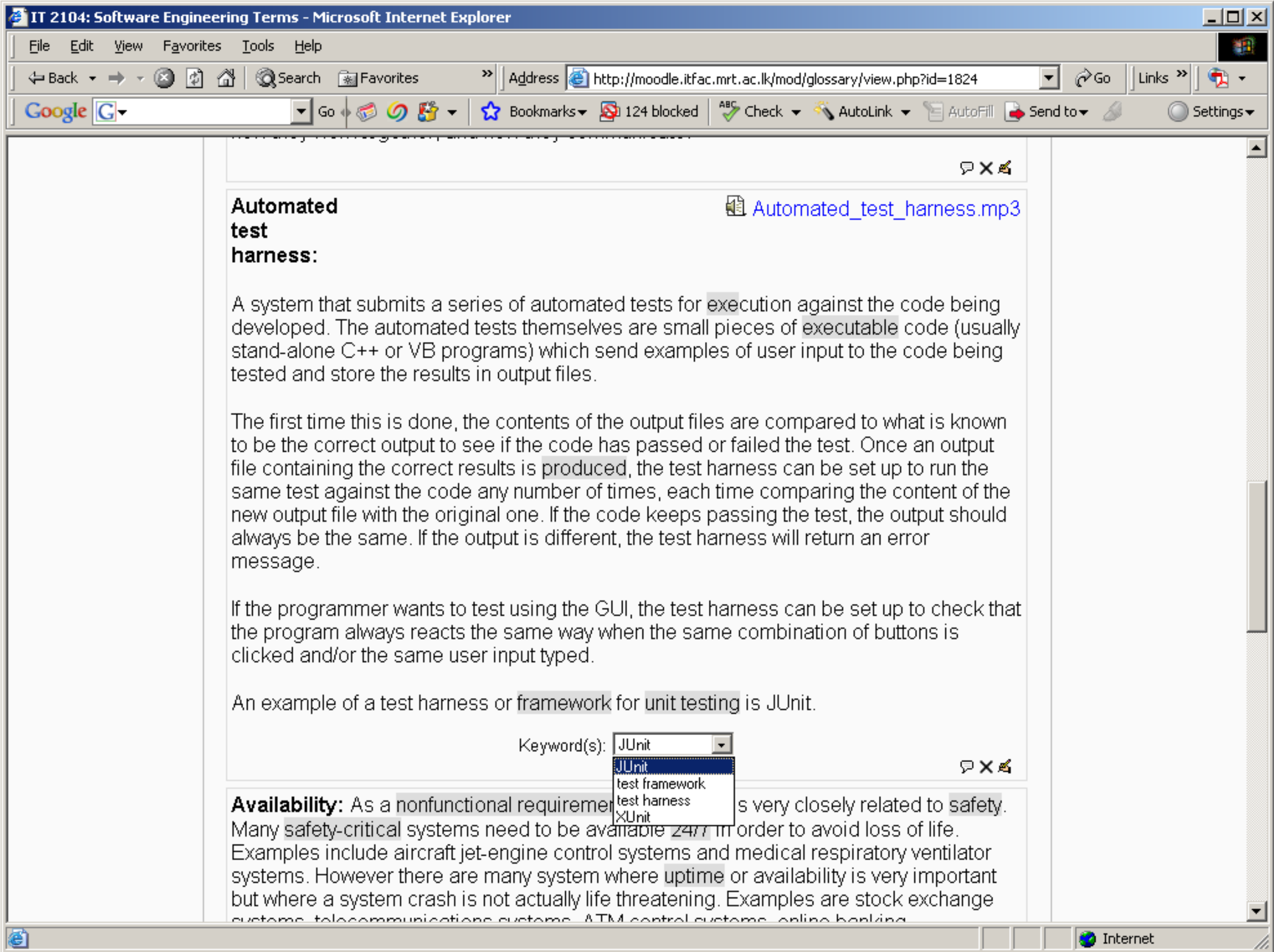
[89] Once a word or phrase is added to the Moodle Glossary, any occurrence of that word or phrase in the lesson text will automatically be highlighted in an unobtrusive light grey. Clicking on the word then takes the student to its definition in the Glossary.



<u>Note:</u>

Words highlighted in grey are linked to the Glossary Module

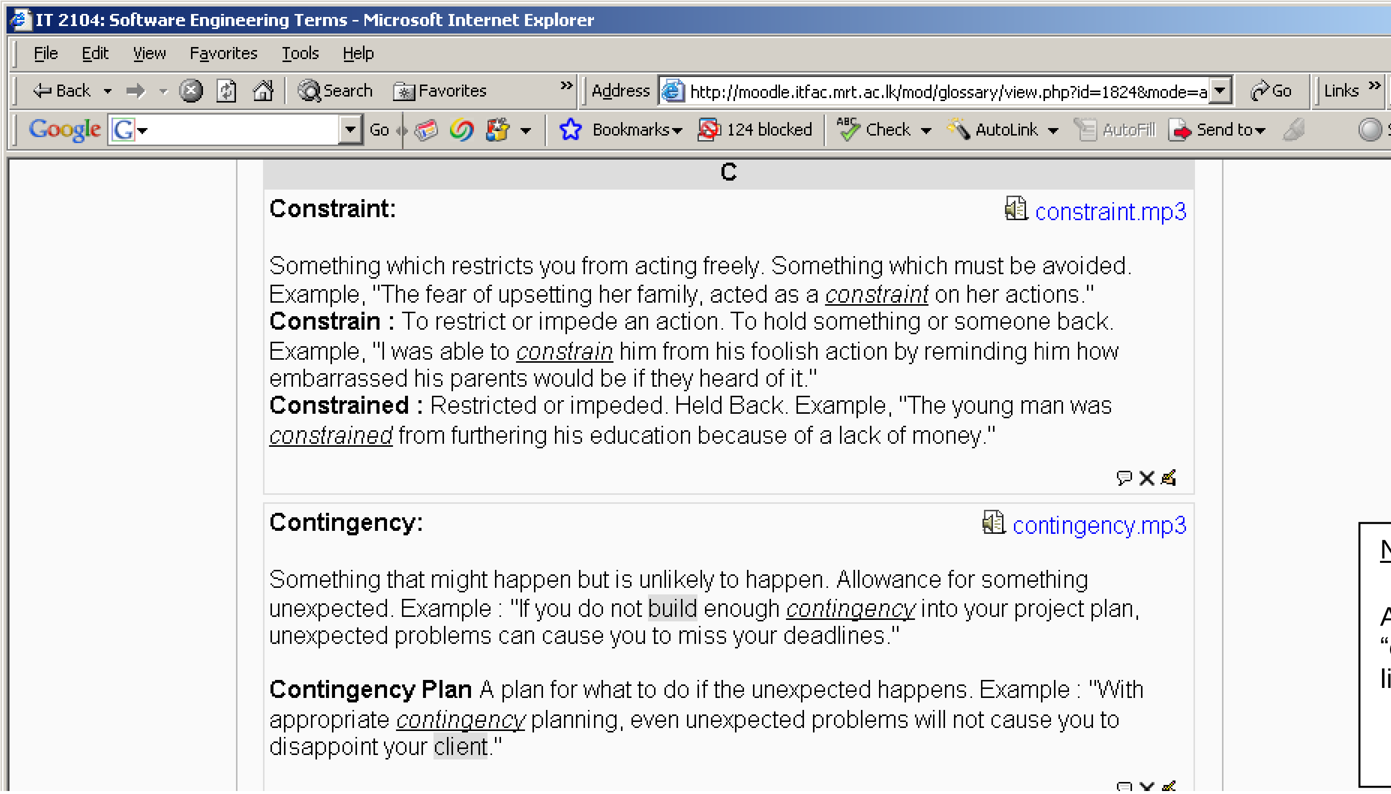
Figure 6.16: Snapshot of a lesson showing part of the text and an end-of-page quiz question



Note:

The link to 'Automated_test_harness.mp3', shown at the top right of the screenshot, is a link to an audio file. The list of Keywords shown at the bottom of the entry for Automated test harness is the list of words in lesson text which will link to this glossary entry. Words highlighted in grey link to other glossary entries.

Figure 6.17: Snapshot of a glossary entry showing a technical term.



Note:

Again, the link to "constraint.mp3" is a link to an audio file.

Figure 6.18: Snapshot of a glossary entry for a non-technical term

Finally, the lecturer and I discussed the need for 'sheltering' the lecture by simplifying the language used, using visual aids and gestures, ‘simple syntax, repetitions and summaries, speaking slowly and clearly, and checking often for understanding’ (Baker 2001, p.195). Given the low level of lecturer-student interaction in lectures, an alternative means needed to be found to check for understanding. It was decided to continue the team quizzes during lecture sessions but to provide questions for the students to avoid the problem of teams asking simple recall questions and to require that any selected person from a team be able to answer the question in English. It was anticipated that this would require coaching of less fluent students within the team (as had taken place in preparation for *viva voce* during 2006) and would prevent students abdicating responsibility for answering in favour of more able students as had happened in 2006. As teams would be allowed to self-select and would presumably do so on the basis of existing friendships, it was expected that there would, in any case, be more of a sense of shared responsibility within the team. Students were advised that their end-of-semester examination might well include similar questions to those posed in lectures.

The case studies that had been introduced in 2006 were dropped from the course in 2007 since they had failed to achieve their objective of building problem-solving skills. Instead students were, once again, given an orientation to problem-solving using the Temasek resources. Following this, tutorial sessions were used to walk through a mock-up of the final assignment. Student teams wrote sections of an SRS for a simple business case using an industry template supplied to them. Their major assignment then involved using the same template to write an SRS for their client. As in other years, the marking rubric for the assignment was given when the assignment was posted online. During the practice sessions, the applicability of the PBL problem-solving process to finding a solution to the described business need, was emphasized. Having gone through the practice exercise first, the course lecturer and I were confident that the students understood the requirements of the assignment. The assignment was given early (before the end of semester rush) and was the only assignment for the semester to help take the pressure off students. As in other years, students were expected to submit the assignment online and feedback was given electronically. Because of the detailed feedback given in previous years to their seniors, it was anticipated that students would be well aware that their assignments would not be marked based only on the ‘beauty and the heaviness of it’ as one focus group participant in 2006 described his experience in other subjects.

To counter problems experienced by team leaders in 2006 getting people together for team meetings, students were given time in tutorial sessions to work on their assignment. The interview session with the client was videotaped and stored on the Moodle™ server so that students could download and watch it at their leisure and the client agreed to contribute to a discussion forum where teams would have the opportunity to ask questions that might arise as they were formulating the SRS. Students were also invited to participate in exercises in preparation for working on the assignment such as drawing a concept map of the system to be designed and a flow chart of Use Cases to describe the system. A Use Case is a description of the function that a module of software in a computing system should perform. Use Cases need to connect seamlessly in order for data to flow through the system correctly and they need to be written with a similar “look and feel”. As the design of any software system includes a large number of Use Cases, it was anticipated that team members would share responsibility for making Use Cases and that the requirement for a similar “look and feel” would promote discussion and collaboration within the team. Three instructors[90] acted as roving facilitators during tutorial sessions together with myself and the lecturer.

Finally, it was decided to trial another approach to dealing with the issue of social loafing – the use of the Wiki module in the Moodle CMS. This module allows instructors to trace the contributions of individual team members to the final group product and students were warned that instructors would be looking out for evidence of freeloading through the semester. At the same time, an emphasis was placed on motivating students to approach the development of their soft skills with the same enthusiasm they approached the mastery of the technical content of the course. To this end, the videos of employers explaining the soft skills they looked for in potential employees were made available as they had been in 2006. Additionally, a national IT workforce survey conducted in 2005[91] was made available online and the hardcopy circulated in the tutorial which focused on employer expectations. This survey was of immediate relevance to students since it dealt with vacancies and opportunities in the local industry, expected starting salaries, desirable educational qualifications and the importance of soft skills to employers in each area of the industry.

[90] Junior members of academic staff who do not have the qualifications to be employed as lecturers but who act as teacher assistants.

[91] SLICTA 2005, *Geared for Growth: The Improving Stability of the Sri Lankan IT Workforce, National IT Workforce Survey*, Sri Lanka ICT Association, Colombo, Sri Lanka

CHAPTER 7

Analysis of Phase 3 (2007) and Implications for an Optimal Learning Environment

The final phase of the intervention into the Software Engineering course in 2007, emphasised providing support for students in the learning process – firstly in terms of support for learning in a second language and secondly in terms of scaffolding the task of doing the PBL assignment. The need for both forms of support had emerged in 2006 as a result of significant changes in the learning context. Findings in 2006 suggested that work on these fundamentals was necessary to provide a foundation for achieving the research goal of designing a learning environment for the effective implementation of a PBL approach as a mechanism for developing graduate soft skills regarded as essential by the ICT industry.

At the completion of this final phase of the study, 24 students participated in three focus groups and 78 students (76% of those enrolled) returned a written Course Experience Questionnaire. This chapter presents the findings from these data sources together with personal observations. It then goes on to make recommendations for an optimal learning environment based on the collective findings from the three years of the study.

7.1 Results

As in the previous two years, transcripts of focus groups were coded for emerging themes / categories of data. The concept map in Figure 7.1 below illustrates the emergent categories and their relationships.

As can be seen from Figure 7.1, many of the categories that emerged from the data in 2006, such as a perceived lack of control over one's own learning, workload stress, the importance of the Kuppi and group study as contexts within which learning takes place, and an orientation toward employability as a primary motivator for learning, reappeared in student comments in 2007. However students' negative perceptions of teamwork and of learning through doing assignments, apparent in 2006, were largely reversed in 2007 and the situation reapproached that described in the first year of the study (2005) where student comments, actions and assessment results all indicated these to be positive learning experiences. Many student teams reported a healthy team spirit with students helping and learning from each other. Knowing that teamwork is important in the IT industry was a primary motivator as in earlier years. Employability prospects were, similarly, a primary motivator to improve English skills, Students felt that the Moodle™ CMS tools provided (such as the glossary and lessons) were valuable in helping them to improve their English but criticised the course for not providing them with enough opportunities to practice English conversation. Overall, the picture emerging from the data (Fig. 7.1) is a far less polarized mixture of positive and negative factors impacting on the implementation of a PBL approach in the FIT context.

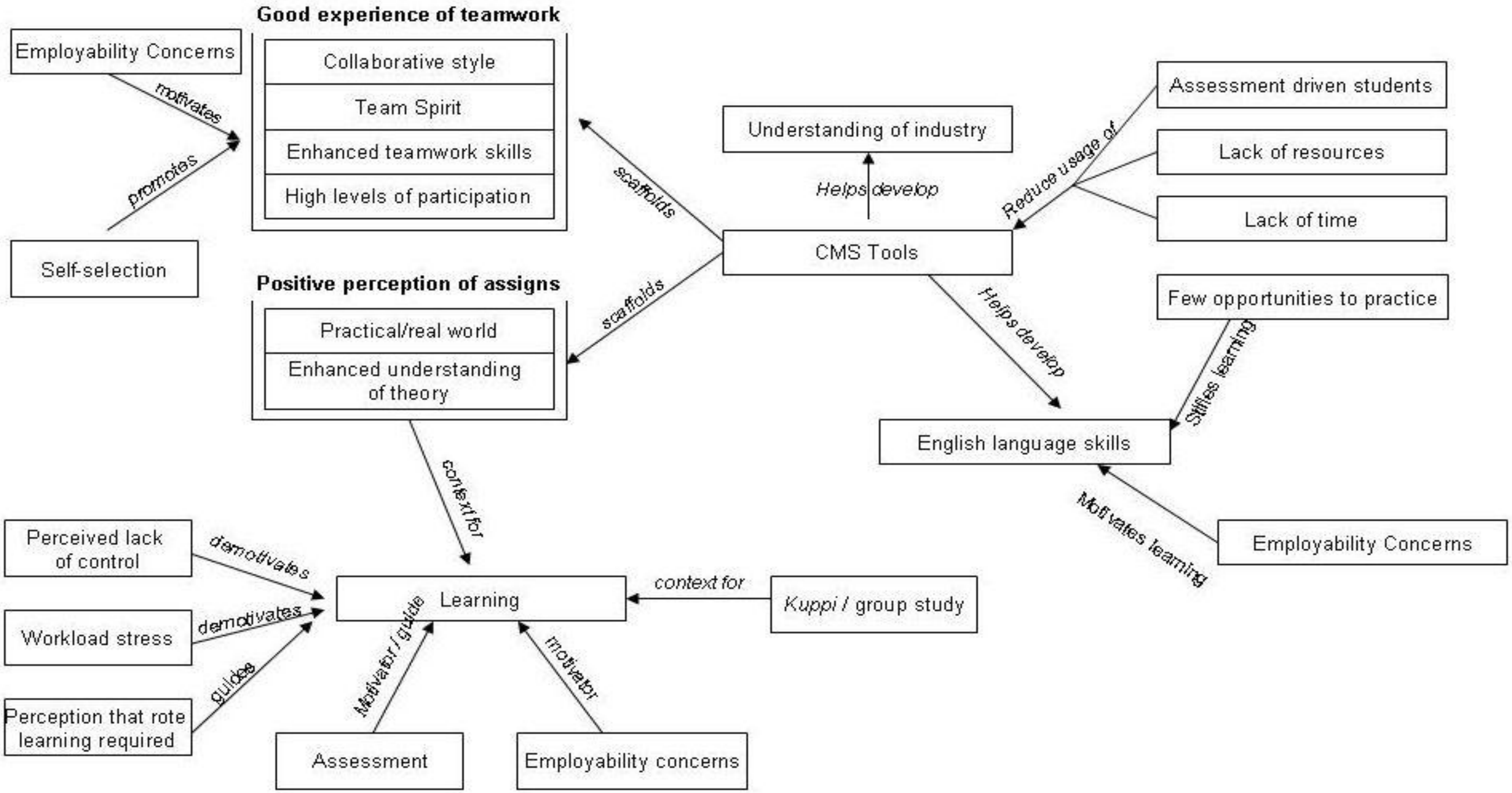


Figure 7. 1: Concept map of emerging categories from data coding in 2007

Table 7.1: Student responses to 2007 Course Experience Questionnaire
(SD-Strongly Disagree, D-Disagree, N-Neutral, A-Agree, SA-Strongly Agree)

	SD	D	N	A	SA	A+SA
1. The subject was interesting and made me think.	3	10	22	38	5	55.1%
2. The workload was too heavy.	1	2	12	28	35	80.8%
3. Doing this subject helped me to develop my ability to work as a team member.	3	2	12	36	25	78.2%
4. I always knew exactly what the lecturer wanted me to do in assignments.	4	10	36	23	5	35.9%
5. It was helpful to have everything on Moodle.	2	6	21	30	19	62.8%
6. It would have been better to have been given the Moodle materials on a CD.	0	7	15	26	30	71.8%
7. Doing this subject has improved my problem-solving skills.	3	5	21	44	5	62.8%
8. Doing this subject has made me interested in further learning.	4	13	24	31	6	47.4%
9. I sometimes felt that my time in class was being wasted.	3	12	17	25	21	59.0%
10. The Glossary on Moodle was very useful to me.	4	3	13	42	16	74.4%
11. The lecturer normally gave me helpful feedback on my work (oral and/or written)..	3	15	34	22	4	33.3%
12. The lecturer tried hard to understand difficulties I might be having with my work.	5	13	32	25	3	35.9%
13. The lecturer was very good at explaining things in tutorials.	12	19	30	13	4	21.8%
14. The lecturer was very good at explaining things in lectures.	17	28	23	10	0	12.8%
15. Because there is so much work in this subject, it is difficult to understand it all.	6	11	24	28	9	47.4%
16. I often made comments and asked questions in lectures.	14	18	34	10	2	15.4%
17. My spoken English communication skills are better as the result of doing this subject.	9	10	37	18	4	28.2%
18. To do well in this subject, all you really need is a good memory.	6	7	9	32	24	71.8%
19. Doing this subject has improved my skills in written communication.	4	5	18	39	12	65.4%
20. We should get individual marks for team assignments based on how much work we do.	14	9	16	25	14	50.0%
21. As a result of working as a team, I now know how a good team leader should act.	4	2	8	35	29	82.1%
22. Doing this course in English was difficult for me.	21	20	15	8	14	28.2%
23. After doing this subject, I feel that I understand software engineering is used in the IT industry.	0	6	15	43	14	73.1%
24. I would prefer to do individual assignments rather than team assignments.	20	23	25	6	4	12.8%
25. Students ideas and suggestions are always considered in this subject.	4	9	23	37	5	53.8%
26. Overall I was satisfied with the quality of this course.	3	7	28	35	5	51.3%

Table 7.2: Comparison of Student Course Experience Survey responses, 2004-2007

STATEMENT		SD	D	N	A	SA	A+SA
Doing this subject helped me to develop my ability to work as a team member.	*2004*	2	7	13	19	5	*52.2%*
	2005	1	0	3	15	14	*87.9%*
	2006	0	10	14	52	6	*70.7%*
	2007	3	2	12	36	25	*78.2%*
I often made comments and asked questions in lectures.	*2004*	12	17	10	5	2	*15.2%*
	2005	0	3	14	13	3	*48.5%*
	2006	15	24	28	13	2	*18.3%*
	2007	14	18	34	10	2	*15.4%*
The workload was too heavy.	*2004*	1	10	9	20	6	*56.5%*
	2005	1	0	3	12	17	*87.9%*
	2006	1	2	9	24	46	*85.4%*
	2007	1	2	12	28	35	*80.8%*
Because there is so much work in this subject, it is difficult to understand it all.	*2004*	2	13	11	11	9	*43.5%*
	2005	2	1	15	15	0	*45.5%*
	2006	1	3	10	42	26	*82.9%*
	2007	6	11	24	28	9	*47.4%*
Doing this subject has improved my problem-solving skills.	*2004*	3	12	12	17	2	*41.3%*
	2005	1	6	7	12	7	*57.6%*
	2006	3	28	28	21	2	*28%*
	2007	3	5	21	44	5	*62.8%*
To do well in this subject, all you really need is a good memory.	*2004*	4	2	7	17	16	*71.7%*
	2005	0	9	8	10	6	*48.5%*
	2006	5	4	21	31	21	*63.4%*
	2007	6	7	9	32	24	*71.8%*
My spoken communication skills are better as the result of doing this subject.	*2004*	5	15	15	9	2	*23.9%*
	2005	2	5	9	12	5	*51.5%*
	2006	7	15	22	24	14	*46.3%*
	2007	9	20	37	18	4	*28.2%*
Doing this subject has improved my skills in written communication.	*2004*	1	2	17	19	7	*56.5%*
	2005	2	3	11	13	4	*51.5%*
	2006	2	13	22	34	11	*54.9%*
	2007	4	5	18	39	12	*65.4%*
After doing this subject, I feel that I understand how software engineering is used in the IT industry.	*2004*	2	3	17	16	8	*56.5%*
	2005	2	2	10	13	6	*57.6%*
	2006	10	23	24	21	4	*30.5%*
	2007	0	6	15	43	14	*73.1%*
I sometimes felt that my time in class was being wasted.	*2004*	5	10	15	12	4	*34.8%*
	2005	4	5	2	15	7	*66.7%*
	2006	1	5	11	22	43	*79.3%*
	2007	3	12	17	25	21	*59.0%*
Students ideas and suggestions are	*2004*	9	7	15	11	4	*32.6%*

always considered in this subject.	*2005*	1	2	8	16	6	*66.7%*
	2006	9	24	28	19	2	*25.6%*
	2007	4	9	23	37	5	*53.8%*
Overall I was satisfied with the quality of this course.	*2004*	0	3	18	18	7	*54.3%*
	2005	1	3	9	17	3	*60.6%*
	2006	17	29	27	8	1	*10.9%*
	2007	3	7	28	35	5	*51.3%*

SD-Strongly Disagree, D-Disagree, N-Neutral, A-Agree, SA-Strongly Agree
n=47(2004), n=49 (2005), n=104 (2006), n=102 (2007)

Table 7.1 presents student responses to all questions in the 2007 Course Experience Questionnaire while Table 7.2 presents the results for items repeated in each year of the study juxtaposed with results from previous years allowing 2007 results to be compared with those from 2004 through 2006. Responses are presented in the same order as they were in Table 5.1 and Table 6.1 and will be cited in the text of this chapter as supportive or counter evidence to the emergent data illustrated in Figure 7.1.

7.1.1 Teamwork skills

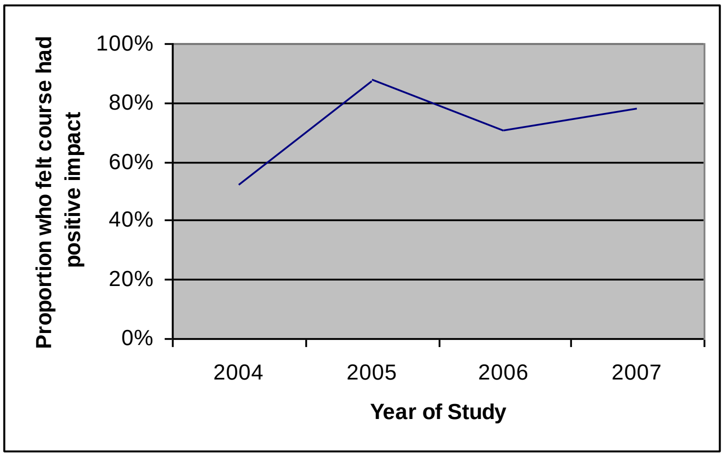
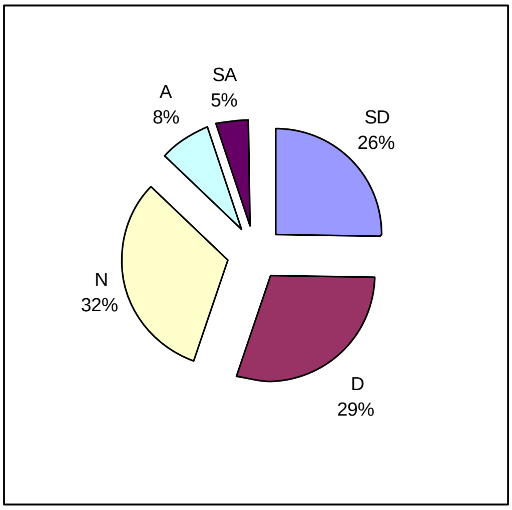


Figure 7.2: Comparison of 2004/2005/2006/2007 student responses to the statement *"Doing this subject helped me to develop my ability to work as a team member"*.

Overall, student satisfaction with team work improved over the course of the study with only 52% of respondents to the end-of-semester Course Experience Questionnaire in the baseline study agreeing that *Doing this subject helped me to develop my ability to work as a team member* compared to 88% in 2005, 71% in 2006 and 78% in 2007 (Fig. 7.2 and Table 7.2).

Differences between the baseline and results in 2005 were significant at the P=0.005 level and between the baseline and 2007 results at the P=0.01 levels. In 2007, not only did students feel that they were more knowledgeable about teamwork, most also indicated a preference for teamwork over individual work. Only 13% of students in 2007 agreed with the statement *I would prefer to do individual assignments rather than team assignments* (Fig. 7.3).



KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

Figure 7.3: Student response (2007) to the statement "*I would prefer to do individual assignments rather than team assignments*".

At the same time, focus group responses indicated higher levels of collaborative learning in teams and many more instances of team members discussing and working together on assignments than was the case in the baseline study or in 2006. Focus group participants talked about researching and discussing what needs to be done before starting an assignment and brainstorming to get ideas. In 2006, students felt that they didn't have time to help team mates or discuss the assignment with them (Chapter 6). In 2007, a typical focus group comment was as follows:

> We divided everything/work among members. There were some students who didn't have a good understanding about the assignment. They said they can't complete their part. Then the others helped them and we explained the important factors and expectations of the assignment.
>
> (Participant, Focus Group 2007)

There were few of the reports of 'forming and storming'[92] that characterised the team stories of previous years. It is assumed that this was because student teams in 2007 were self-selecting whereas those in 2005 and 2006 were selected to maintain diversity of ethnicity, gender and English language fluency. One would not expect to have the same level of difficulty in forming a team identity with a group of friends that might be experienced in a more heterogeneous group environment.

Some 81.2% of respondents in 2007 agreed that, *As a result of working as a team, I now know how a good team leader should act* (Table 7.1). The following descriptions by focus group participants of ideal team leader qualities, demonstrate the accuracy of this perception.

> As a group leader you must be able to appreciate everyone. Then we can get them to work better. And to allocate jobs for the members. And must encourage everyone continuously … Must be able to get the maximum effort from the team members. The maximum effort depends on person to person. Some may excel in responsibility; some don't like to be forced, like that. According the nature of that person, he must know how to reach him and get him to do the work.
>
> (Participants, Focus Group 2007)

[92] From Tuckman's 1965 model of group dynamics (Levin 2005).

As in 2006, concerns about employability emerged as a primary motivator for students and contributed to their perception of the importance of developing teamwork and other soft skills (Fig. 7.1). Students' comments indicated that they were aware that IT employers wanted to recruit people with effective teamwork skills and, as a result, were keen to develop such skills.

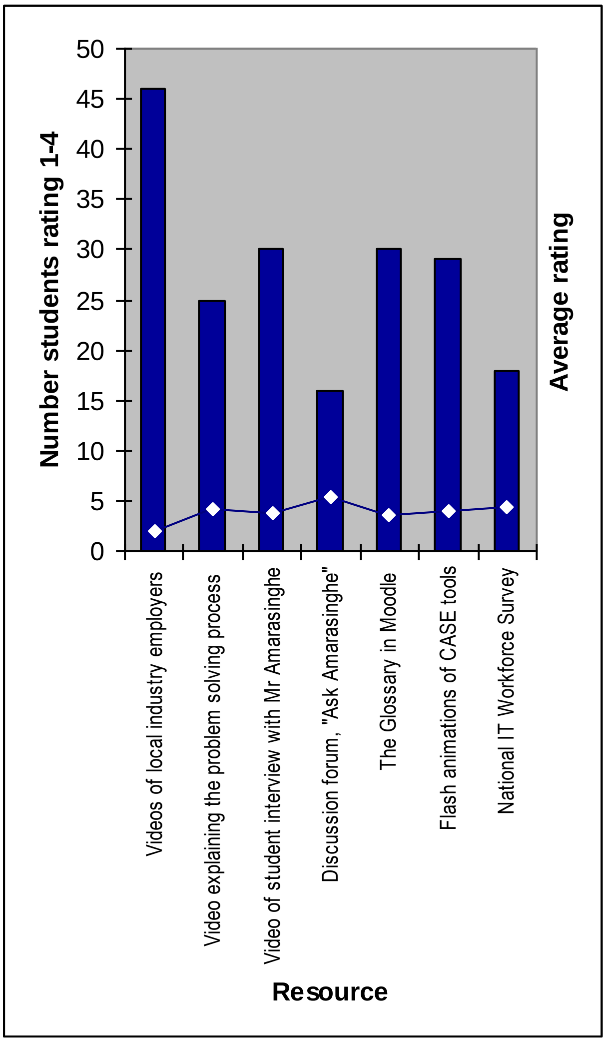


Figure 7.4: Relative perceived usefulness of learning resources provided in 2007
Note: Students were asked to rank resources from 1 (most useful) to 10 (least useful). The column graph depicts the number of students (n=102) who ranked each activity above the mid-point (5) while the line graph shows the average rating for each resource

One important source of information for students about employer expectations were videos of local employers explaining the types of skills they looked for in potential employees. Asked to rank resources provided during the course from 1 (most useful) to 10 (least useful), students responding to the questionnaire in 2007 gave these videos an average ranking of 2.02 – the highest amongst the seven resources listed. As Figure 7.4 shows, far more students assigned a high ranking (between 1 and 4) to this learning resource than was the case for other learning resources. By contrast, reading the National IT Workforce Survey for information about IT jobs in Sri Lanka, which was also intended to motivate students and inform them of employer exectations, was ranked comparatively lowly (in position 6 out of 7 with an average rating of 4.38). This was consistent with other findings in the study where students consistently rated video and graphical resources as being more useful than written documents.

7.1.2 Peer Assessment

In 2007, use was made of the Wiki module of Moodle™ not only as a vehicle for student collaboration but also as a means of monitoring team participation. This module allows instructors to trace the contributions of individual team members to a final group product. Although the lecturer and I had no intention of awarding individual grades based on Wiki contributions, students had the impression that it would be used for this purpose and reacted accordingly. This resulted in high levels of team participation with positive implications for the teamwork experience of most groups. Through tracing contributions to the Wiki, it was apparent that 75% of groups enjoyed significant levels of participation from all team members while in the remaining groups, there were instances where contributions were not recorded by one or more of the members. However, when team leaders were approached to confirm the assumed freeloading, they uniformly denied it. In some cases, teams had actually worked collaboratively on the assignment outside the campus and subsequently uploaded the content to the Wiki platform with the result that all input was recorded as belonging to the student who was logged in at the time of the upload; in other cases, some team members had made a valid contribution to the work (such as researching information, drawing diagrams or working with other team members) but had not physically typed a contribution. However freeloading did occur and some of the issues that had stifled participation in previous years, such as team leaders discouraging members poor in English from contributing to team reports, re-emerged in 2007 as evidenced in the email received from a student in 2007 and reproduced below.

> August 18, 2007
>
> Dear Deborah Madam,
>
> I am XXX and a member of group XXX. Please madam, i kindly requast you not to give me smaller marks. I accept, that i didn't write much thing than others in our group assignment. Because I have a little knowlage of English and we thought that same marks will recived by all the members. And also we thought, if I wrote much others also recive less marks.Thats why I didn't write much thing in our assignment. But we discused about the assignment and how to write it and get ideas about the assignment from all the members and we warked as a group.
> Another thing is I am in a acardemic warnning madam. If I get law marks in this semister I will be batchmissed. So please madam, I kindly request you again. Please give me some more marks.
>
> Thank you
> XXX

One negative outcome of the student misperception that Wiki reports would be used to award individual grades is illustrated by the following focus group comment describing how the situation instigated some competitiveness within the group.

> Sometimes lecturers allocate high marks for some parts of the assignments. So some students can get high marks when they complete that important part. Sometimes we discuss everything with our members but writing part is done by one member. That member can get high marks. This system is not fair. They can't find our real participation for assignments using this "wiki" system. But the advantage of this system is that all members must try to give their maximum contribution.
>
> (Participant, Focus Group 2007)

This is consistent with findings by Cohen (2002, p.15) that 'If students expect to be evaluated as individuals, rather than as a team, there will be some students who will intentionally take on more work than is fair'.

However, this response needs to be considered in juxtaposition to the 2007 student feedback where 50% of students agreed with the statement *We should get individual marks for team assignments based on how much work we do* (Fig. 7.5) and in light of the negative effect that social loafing had on student teamwork experience in previous years. The gains to be made using the wiki module to enhance individual student accountability arguably offset the risk that some students would take on more than their fair share of the work.

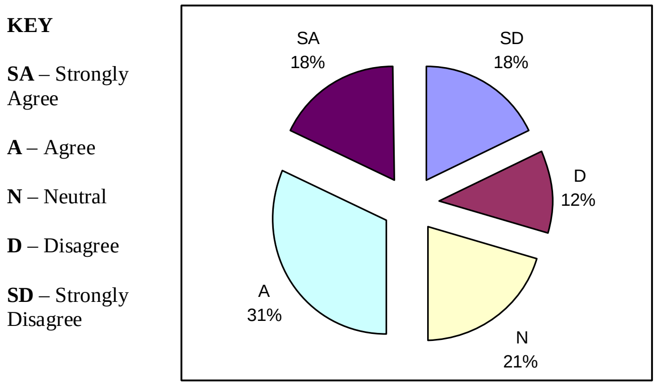


Figure 7.5: Student response (2007) to the statement "*We should get individual marks for team assignments based on how much work we do*".

In 2007, continuous assessment results improved to the highest level since the introduction of PBL to the course. The class average was 83% compared to 69% in 2006, 78% in 2005 and 72% in the baseline study (Fig. 7.6). These improved results may well reflect increased participation in teamwork.

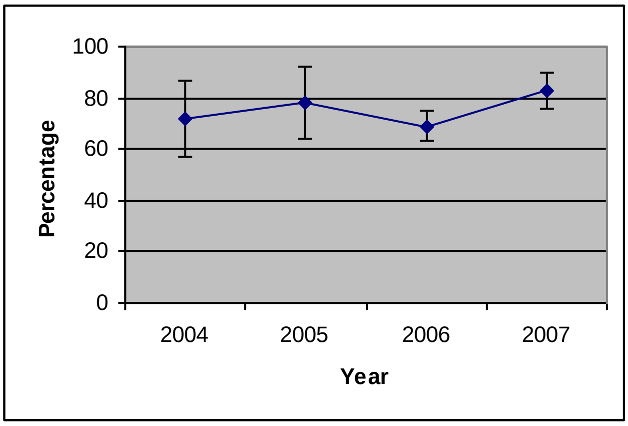


Figure 7.6: Average continuous assessment results 2004 – 2007
Note: Error bars indicate standard deviations

7.1.3 Problem solving skills

The extra-curricular pressures that created such a high level of perceived workload stress for students in 2006, were not present in 2007. The assessment load in Software Engineering had also been significantly reduced with only one assignment, no required reflections, very few tutorial exercises and a significant amount of time in tutorials made available for teamwork in the weeks prior to the due date for the assignment. Despite this, the frequency with which focus group participants took the opportunity to voice complaints about assignment overload and lack of support from the faculty indicated that they still perceived that they were working under pressure.

Despite all this, student comments indicated that they felt that their assignments and projects were valuable learning experiences and helped to build their problem-solving skills.

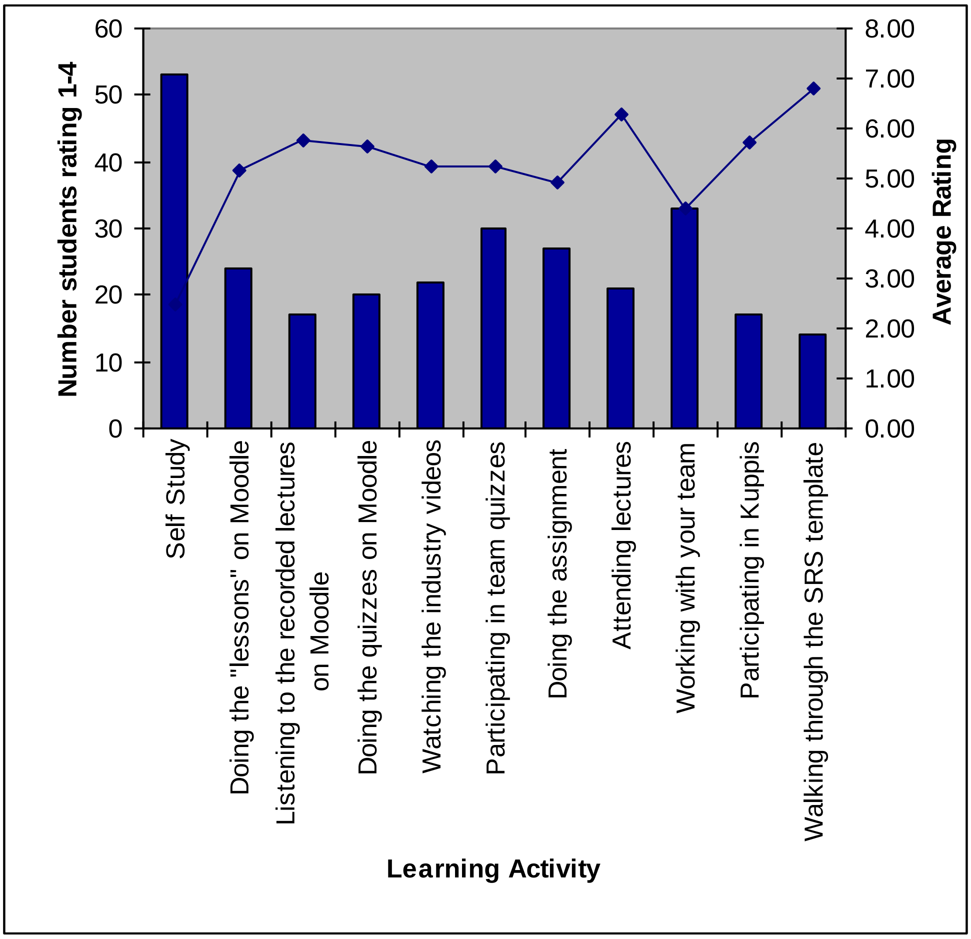


Figure 7.7: Perceived usefulness of learning activities experienced in 2007
Note: Students were asked to rank resources from 1 (most useful) to 10 (least useful). Columns depict the number of students (n=102) who ranked each activity above the mid-point (5) while lines show average ratings.

Asked how much each of a series of ten learning activities experienced in the Software Engineering course helped them to learn the subject, students ranked working with their team and doing the assignment second and third respectively (Fig. 7.7). Self-study, consistent with findings in previous years, was ranked first.

> My opinion is that rather than the final exam, we get more knowledge from these kinds of assignments. Last time the MIS assignment was on how a company would success or fail by using E-Commerce. From that we got to know how e-commerce works and what areas we need to focus on in e-commerce. When doing a project what kind of resources do we need to have. We learned all that from that assignment. When that kind of assignment is given, we definitely do research about it. Somehow we do it. Also for Software Engineering we had to prepare a SRS. That is good because SRS is something we'll have to do in the future. This is not where we copy and paste from net. Have to do it ourselves. If it was an ordinary assignment, we'd just be doing it for the sake of submitting it. Other than that is not interesting at all. But there must be a proper deadline. If they give about a week what we do is either just do it or copy from someone else. Therefore time period is important too.
>
> (Participant, Focus Group 2007)

The assignment was done well by most groups with little evidence of plagiarism unlike in 2006. Having reviewed, in tutorial sessions, URLs written for an example computer system at a hospital, most groups were then able to identify and construct URLs for the CarMart system (CarMart being the real world client for the assignment). The solutions they came up with for CarMart's maintenance system requirements indicated that they had understood the company's requirements and were able to apply their knowledge of concepts such as functional and non-functional requirements to describing their solutions in an appropriate SRS format. None of the focus group participants claimed to have been unable to understand the assignment although two people commented that it would have been good to have been given a worked example of an SRS rather than merely a template. Based on their experience of designing a system for CarMart, 62.8% of students in 2007 claimed that *Doing this subject has improved my problem-solving skills* compared to 41.3% in the baseline study - a difference significant at the P=0.01 level (Fig. 7.8). Continuous assessment results (Fig. 7.6) supported their claim, climbing to the highest level since the start of the study.

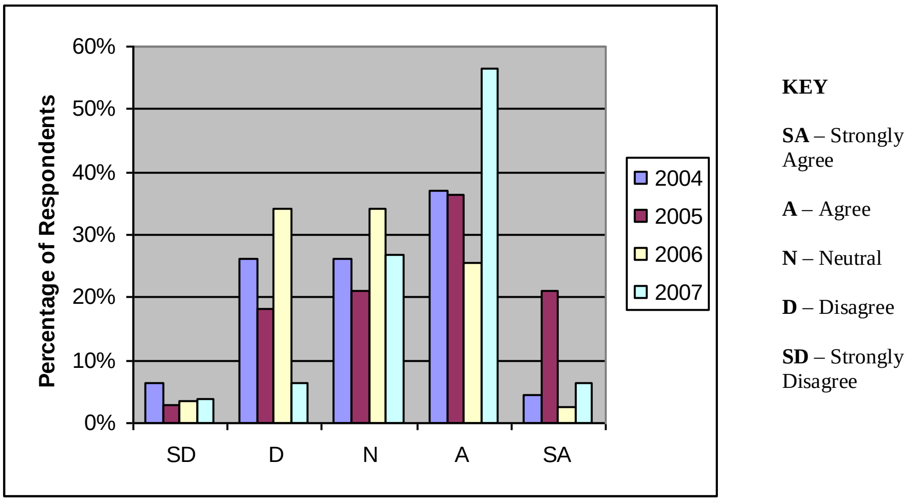


Figure 7.8: Comparison of 2004/2005/2006/2007 student responses to the statement "*Doing this subject has improved my problem-solving skills*".

7.1.4 Communication skills

English language fluency continued to be a problem in 2007 particularly as these students had missed out on the foundation English language course in their first year (refer to Chapter 3). In responding to the Course Experience Questionnaire in their second year of study, 28% of students agreed with the statement, *Doing this course in English was difficult for me*, and only half the class (53%) disagreed with the statement (Table 7.1).

The response to the array of resources provided for ESL support in 2007 – the online glossary, the Moodle lessons, and the lectures with voiceover - was very positive. A total of 74% of students responding to the questionnaire in 2007 agreed with the statement, *The Glossary on Moodle was very useful to me* (Table 7.1), while only 9% disagreed with the statement. Asked to rate resources provided to them during the Software Engineering course from 1 (most useful) to 10 (least useful), students gave the second highest ratings to the Glossary module in Moodle with an average rating 3.6 (the highest ratings went to the video of employers talking about desirable skill sets for potential employees – an average rating of 2.02) (Fig. 7.4). The following comment is typical.

> Moderator: Do you think the Glossary is important?
>
> Participant 1: Yes it is very important. There are so many technical words. We can get an idea about these words using the glossary.
>
> Participant 2: Some times we don't understand the lesson because of just one technical word. So the glossary is very important.
>
> (Participants, Focus Group 2007)

Students did, however, note a number of limitations to the implementation of the glossary and made useful suggestions for how it might be improved. One student suggested making the tool more interactive so that students could decide what English words needed to be defined. Non-technical terms to be defined in the glossary had been selected on the basis of inputs from a small group of students and the course lecturer, but clearly this could not be expected to meet the needs of all.

> There are some English words, difficult to understand, that are explained through an online dictionary. That is very good, and can be improved. Like the student cannot select the difficult words, we have to learn from what they have chosen. If we can chose the words and get the meaning, so that every word is explained, it would be good. Because one word that I understand may not be understood by another. They have put only what they generally believe that we do not understand. There are some words that cannot be understood even with the explanations. Then either Sinhala or Tamil can be used.
>
> (Participant, Focus Group 2007)

In fact, a discussion forum was provided for this purpose where students were invited to send in requests for definitions either on their own behalf or where they thought inclusion of the word in the glossary might benefit others. In the entire semester in 2007, only one such request was made. This may have been because users had to exit the glossary and/or lesson to enter the discussion forum. Allowing them to link directly to a "suggestion box" from within the glossary may have achieved better results but this approach was not tested. Suggestions that it might have been good to define words in Sinhala and Tamil in addition to the English explanation were made by participants in all focus groups from 2007 and even in some focus groups in previous years prior to the introduction of the glossary but this was not done as difficulties in using Sinhala and Tamil script in the help screens could not be resolved in time.

> Moderator: Do you think it's necessary (explaining the difficult words in Sinhala and Tamil in a glossary)?
>
> Participant: When the English definition is there it doesn't go to the brain completely, because we don't think in English, we think in Sinhala. So if we get the idea in Sinhala then we can convert it into English later. Remembering a word in English, means something like memorizing now. Ideas don't come to the mind. If the idea is given in Sinhala we can convert that in to English at any time
>
> (Participant, Sinhala-medium Focus Group 2005)

Finally, one student requested a printed copy of the glossary to be used in situations where a computer was not available.

Moodle lessons were also valued by students. Asked how much each of a series of ten learning activities experienced in the Software Engineering course helped them to learn the subject (Fig. 7.7), students ranked doing the lessons on Moodle fourth (average rating 5.14) after self-study (average rating 2.49), working with their team (average rating 4.39) and doing the assignment (average rating 4.90). The lecture notes with voiceover were much less highly rated (ninth out of the eleven activities listed with an average rating of 5.76) (Fig. 7.9). This may have been because the new format (embedded mp3 files in PowerPoint) was only made available part way through the semester due to lack of time to prepare the files at the beginning of the semester. Figure 7.9 shows usage statistics for the lecture notes with voiceover (lectures are listed in the order they were given in the course from top to bottom) and illustrates a substantial drop in usage after the first week to almost no use by students after week six.

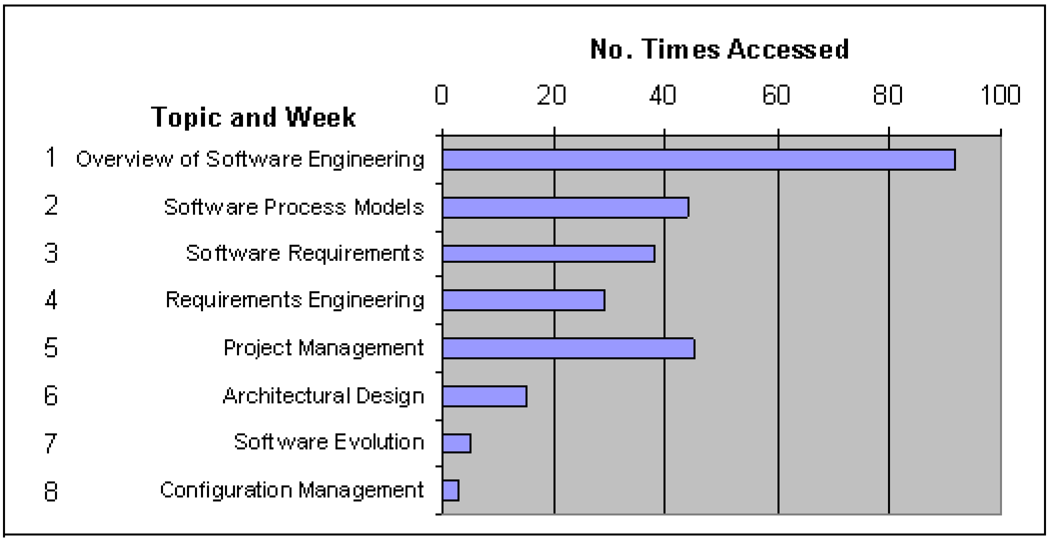


Figure 7.9: Usage statistics for students accessing electronic lecture notes with voiceover in 2007.

However, despite the expressed appreciation of the technology support, most students felt that the course did little to help them with their oral communication since it did not provide them with opportunities to practice speaking in English. Only 28.2% agreed with the statement *My spoken communication skills are better as the result of doing this subject* compared to 46.3% in 2006 and 51.5% in 2005 (Table 7.2). In previous years, class presentations, facilitated group discussions in English medium and even the *viva voce* had provided such an opportunity but these were missing in 2007. The only opportunity most students had to speak in English was in lectures particularly in the context of the inter-team quizzes. Students felt that the course convenors should have done more to provide them with opportunities to interact in English – particularly in an industry context.

KEY

SA – Strongly Agree

A – Agree

N – Neutral

D – Disagree

SD – Strongly Disagree

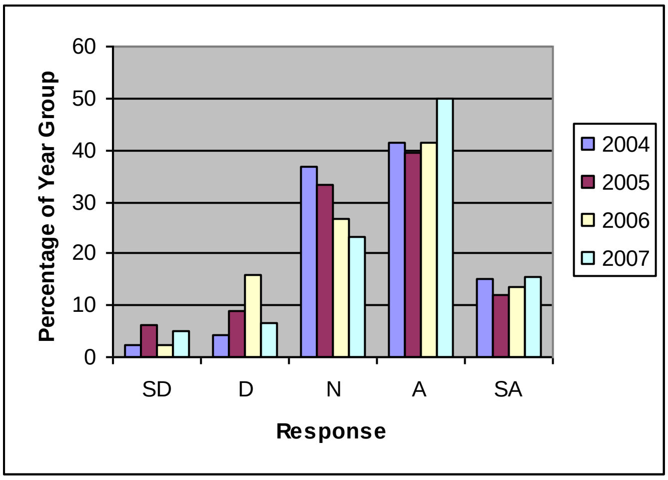


Figure 7.10: Comparison of 2004/2005/2006/2007 student responses to the statement "*Doing this subject has improved my skills in written communication*".

However as the result of having completed the documentation for the major assignment, students felt that their written communication skills had improved significantly with 65% of the 2007 batch agreeing with the statement, *Doing this subject has improved my skills in written communication* - the highest of all years (Fig. 7.10). In 2005, 51.5% of respondents agreed with this statement; in 2006, 54.9%; and in the baseline study, 56.5% (Table 7.2). The difference in the 2007 result was not, however, statistically significant.

7.1.5 Independent Learning Skills

As in previous years, students did not demonstrate effective time management in studying for the subject. While students valued the online tools developed to help them in 2007, these tools were not used as effectively as they could have been, largely being accessed in the weeks immediately prior to the end-semester examinations.

Figures 7.11 and 7.12 below show Moodle™ statistics from the 2007 site collected immediately prior to the reading week[93] and again immediately after the exams which reveal high levels of student access of resources early in the semester when time was allocated for this in tutorial sessions with a rapid drop-off after the third tutorial as comparatively more tutorial time was allocated for preparation of the assignment. Based on the pattern of access of online tools such as the lecture notes with voiceover (Fig. 7.9), the lessons (Fig. 7.11) and the quizzes (Fig. 7.12), it would appear that students used computer lab sessions after the second or third week almost exclusively for doing their Software Engineering and other assignments rather than for self-study.

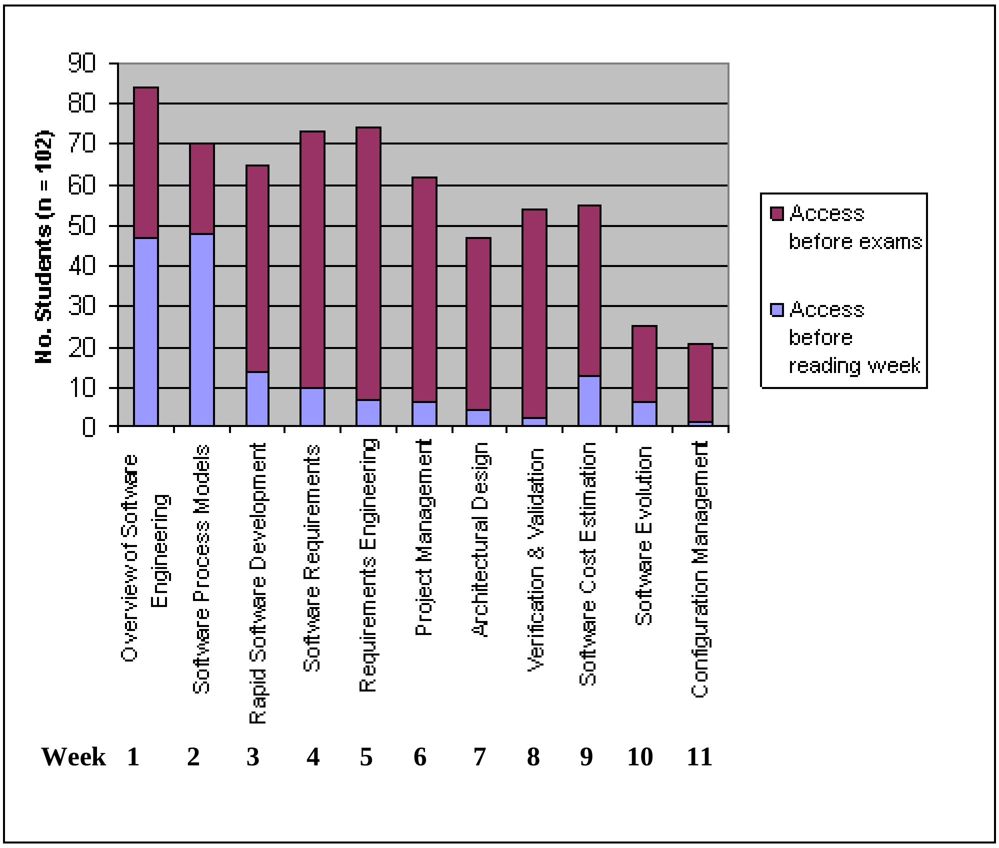


Figure 7.11: Pattern of student usage of Moodle™ lessons over the semester in 2007
Note: Source of information: Moodle™ usage statistics.

[93] A week free of lectures immediately prior to the end-of-semester examinations when students are expected to study for the exams.

The 2007 cohort were no different to previous year groups in their preference for studying in groups or attending *Kuppi*. Both preferences were emerging themes in the focus group discussions, as they had been since the start of the study. Study groups meet in a range of venues not necessarily equipped with network access (or even computers) and in the weeks immediately before the end-of-semester examinations. Students were also provided with copies of the Moodle resources on a CD immediately prior to the reading week (explained further below). Given that this was the case, it might have been expected that online Moodle resources would be underutilized. However, Moodle system statistics show significant activity towards the end of the semester and in the reading week (Figures 7.11 and 7.12). This same pattern of activity was observed in 2005 (Fig. 5.9) although the trend was more pronounced in that year.

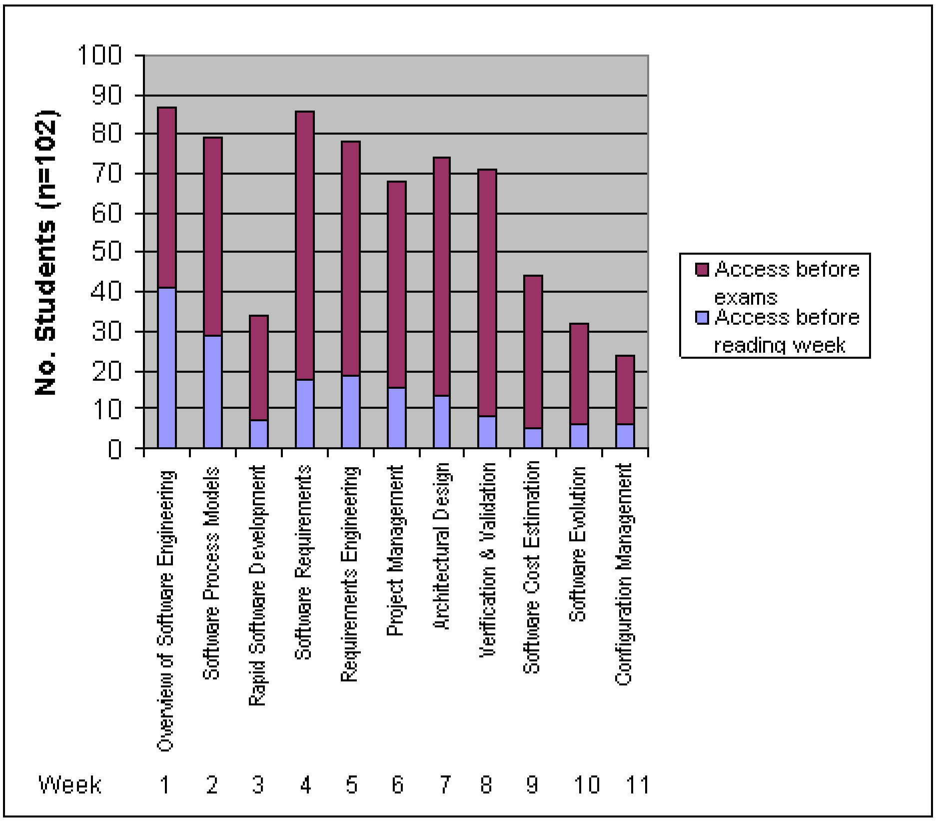


Figure 7.12: Pattern of student usage of online quizzes over the semester in 2007
Note: Source of information: Moodle™ usage statistics.

FIT students are not atypical. Many start with good intentions but, under pressure, become assessment driven as the following comment illustrates:

> Moderator: So did you actually use those quizzes?
>
> Participant: The beginning like within the first 3 weeks I think I did about five quizzes. It really helps to understand the deeper meaning of the subject. But in the middle part I think I just lost the track of that. At the latter part, just before the exam we all did the quizzes and that really helps to remember things. Not like reading a book. I'm just not fond of reading the book. You can't remember software Engineering by the book. Those MCQs[94] helped.
>
> (Participant, Focus Group 2005)

[94] Multiple choice questions

As all topics are allocated equal weighting in the end-of-semester examination, access to all topics should have been equivalent. The fact that access drops off steeply for the last two (Fig. 7.11) or three (Fig. 7.12) topics, probably indicates that students ran out of time to study these topics. This is not surprising if usage of online resources was left until the reading week.

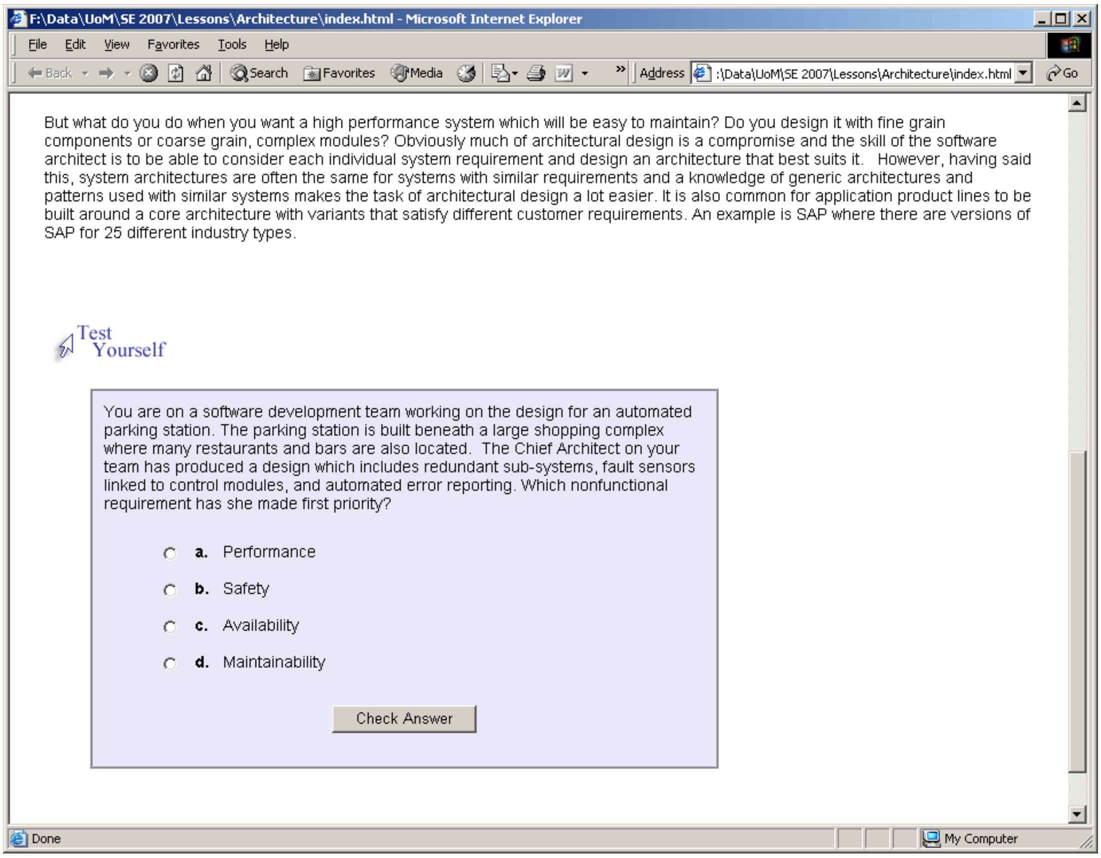


Figure 7.13: Snapshot of SoftChalk™ lesson showing quiz inline with SoftChalk™ lesson text

In previous years, students had complained that lack of computing resources and access to computer labs were a limiting factor in their ability to make use of online tools. For this reason a CD was made to replicate the content on the Moodle system using SoftChalk LessonBuilder 3™.[95] In SoftChalk™ lessons, it is possible to include quiz questions following all of the same formats to be found in the Moodle Quiz Module and to place these quiz questions in line with the text (Figures 7.13 and 7.14). SoftChalk lessons are created as standalone html files which can be run from a CD. A simulated glossary function was created by converting all of the glossary entries to individual html files and creating hyperlinks in the text to link these files.[96] The CD was intentionally withheld until immediately prior to the exams bearing in mind the experience of Saunders and Klemming (2003), who provided their students with all course materials on a CD at the beginning of their course only to find that

[95] LessonBuilder 3 also allows the designer to construct a lesson where a multiple-choice or similar format quiz question is inserted after a page of content. LessonBuilder 3 generates html files which can then be burnt onto a CD.

[96] This process was automated using an MS Word concordance table to index the document and then changing all of the index tags to hyperlinks. The advantage of using a concordance table is that, once created, the table can be run against any html file (or any file that can be imported to MS Word). This functionality would allow other lecturers who wished to create a similar resource to automatically create hyperlinks for their own files. The only disadvantage of this approach is that because of the Java script inserted by LessonBuilder3, the files had to be saved in MS Frontpage not Word.

they then tended to skip classes or use their lab sessions to complete coursework for other modules or to read their email because the availability of the electronic materials was perceived by students to be something which they could fall back on in the lead-up to exams.

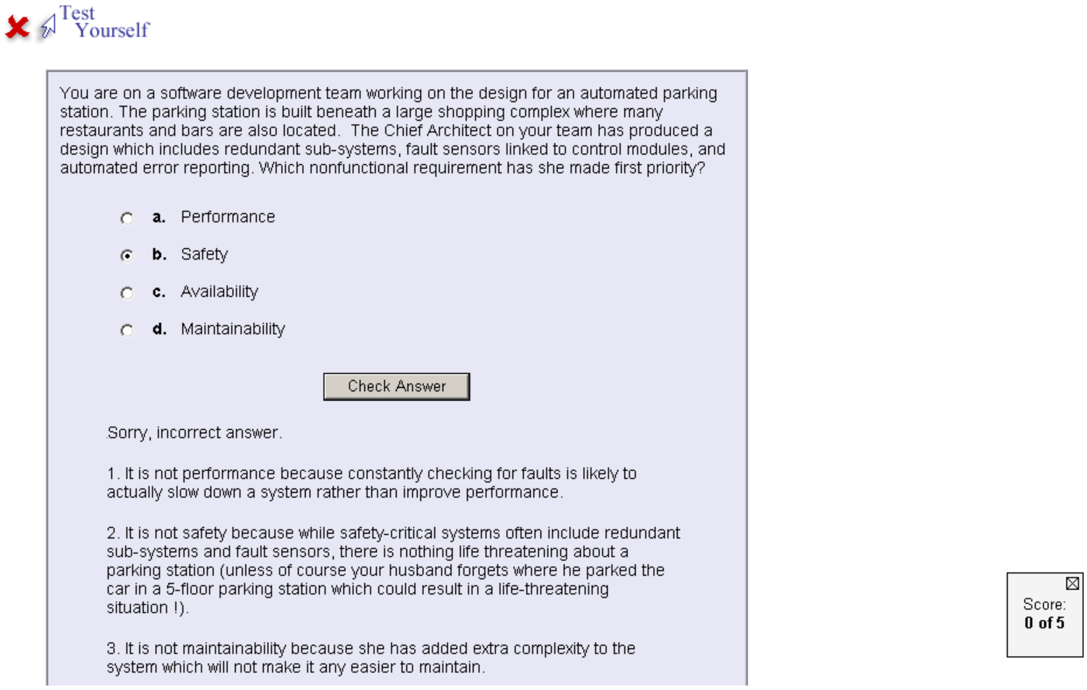


Figure 7.14: Quiz feedback shown inline with SoftChalk™ lesson text

Because the CD was handed out after focus group sessions and after students had completed the Course Experience Questionnaire (about 3 weeks before exams), students were not asked on the Course Experience Questionnaire whether they had used the CD but rather whether *It would have been better to have been given the Moodle materials on a CD*. 72% of respondents agreed with this statement (Table 7.1) while 63% of students also said that *It was helpful to have everything on Moodle* (Table 7.1). This probably reflects the difficulty of gaining computer lab access, particularly later in the semester when students from all classes and year levels were competing to gain access to computers in order to finish their assignments. Resources stored on a CD could be accessed using standalone computers in homes and boarding houses. It may also be related to the tendency of most students to study (and use the Moodle CMS resources) only in the lead-up to exams as noted from the examination of web statistics earlier in this chapter.

While the above analysis points to students not taking effective control of their own learning, another central category or theme emerging from the data in both 2006 and 2007 was a student perception of not being allowed control over their own learning (Figures 6.1 and 7.1). The primary contributing factors revealed in focus group sessions in 2007 (as in 2006) were an overload of poorly scheduled assignments with lecturers scheduling assignment due dates for the same day or close together, lecturers not notifying students of assignment due dates at the start of semester, little feedback on assignments, a lack of transparency in the marking system, and a mandatory requirement to attend at least 80% of lectures. Students wanted the right to choose not to attend lectures if they saw the lecture as being of limited value or if they perceived that their time could be better spent elsewhere – in other words, to take control of their own learning. Lecturers, on the other hand, were concerned that students might not have the maturity to manage their time well. They felt that they had a duty of care to their students to ensure that they received the full value of the academic inputs available from the faculty.[97]

Factors such as lectures being scheduled in the reading week close to exams and/or being cancelled with little notice did not emerge as issues as they had in 2006 indicating that these problems, largely tied to the move back to the Moratuwa campus, had been resolved. However, again reminiscent of 2006, factors such as lack of access to computing resources and lack of support from faculty staff in the second year project were seen as contributing to workload stress. Students had an expectation that staff would personally mentor and guide them in completing their second year project and, when this expectation was not realised, they saw staff as being unsupportive. It is possible that this sense of not being supported in their learning and not being able to exercise control over their learning environment was a greater contributor to perceived workload stress than actual workload which, as explained above, had been considerably reduced for Software Engineering in 2007. It is also possible that the timing of focus groups was a factor in that these were held in the latter part of the semester at a time when student feedback indicated that most of their assignments fell due.

The 80% lecture attendance requirement was strongly resented in the Software Engineering course where students found the lectures to be of little value – merely a presentation of theoretical content from the textbook. Lectures were consistently regarded as the least useful element of the learning environment in Software Engineering. Students in both 2006 and 2007 gave lectures the lowest rating of all elements of their learning experience: an average of 6.39 and 6.26 respectively on a scale of 1 – most useful to 10 – least useful (Figures 6.7 and 7.7). Although most respondents did not answer the open-ended questions in the 2007 questionnaire, many of those who did (43 of the 78 respondents or 55%) were critical of the lectures suggesting that more effort be made to make them more interesting and/or to improve their practical and professional relevance.

Nor were negative comments reserved solely for Software Engineering lectures:

> Participant : Sometimes our lecturers conduct lectures for 4 hours; their aim is to finish the syllabus. But it is not effective. Actually students are not getting anything from those long lectures. Normally people can’t concentrate for any thing more than two hours.
>
> Moderator : So how can [lectures] be improved?
>
> Participant : Rather than trying to cover the whole book, it may be better to cover some parts and let us read further. For those who have interest will do anyway if they are going to major it. Don’t have to teach each and everything. Have to provide a good basic knowledge. Sometimes we don’t know the concepts. That must be taught first, and then we can follow. Otherwise we understand it after a long time.
>
> (Participant, Focus Group 2007)

In 2005, student comments made in focus group sessions to the effect that it was very difficult to concentrate for lecture times of up to three hours, were passed on to the Dean of the Faculty. The point was made that this was not unusual for students learning in a second language where it was necessary to concentrate on both the

[97] Personal comments from Dean and academic staff.

content of the lecture and the language used. As a result, the faculty subsequently decided to limit lecture times to 1.5 hours. It is of concern that, only two years later, the length of lectures was again tending to increase, presumably to facilitate covering the syllabus content. The following comment by a senior lecturer at the start of the study, illustrates the faculty concern that their students graduate with an impressive breath of technical knowledge.

> From the moment they come here, we concentrate more on the knowledge side to make sure our students are having superior knowledge to other departments and this is culturally right, socially right and what is expected. And we have to do it. One of the key criticisms that come to the university students would be lack of skills and lack of ability to apply so because of that we want to make sure that our students are not only knowledge based students - especially those students who have the knowledge but can't share it within a team. But the expectation of society is as long as they have the knowledge and can use it, it is enough.
>
> (Senior Lecturer, Academic Staff Interview 2005)

However, a number of students made the point that what they had was not knowledge but content rote learnt for examinations and quickly thereafter forgotten.

> ..what we write from understanding and what is in the book are two things. So if we can't give the exact answer according to the book, we don't get marks. Those who just memorize and doesn't even know the concept may get marks than the other. There are people who memorize a java programme for the exam. But who know the language does not get marks if he does it in some other way.
>
> (Participant, Focus Group 2007)

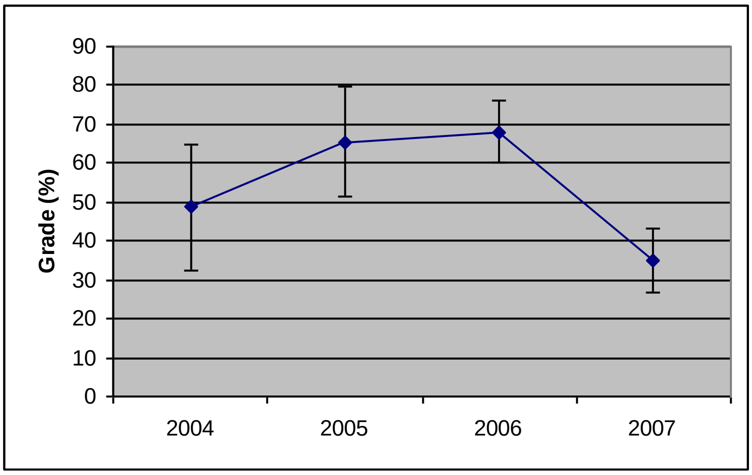


Figure 7.15: Comparison of average grades for summative assessment 2004 – 2007
Note: Standard deviations shown as error bars.

In 2007, 71.8% of students agreed with the statement *To do well in this subject, all you really need is a good memory* (Table 7.1) indicating an expectation that it would be possible to "cram" or rote learn for the exams. This was almost precisely the same proportion (71.7%) as in the 2004 baseline study (Table 7.2). While this may have been the perception of students, in actuality, efforts were made to ensure that questions in the end-of-semester examination in 2007 were not of the type to encourage mere replication of the course notes but instead demanded analysis and application skills. This was done in response to this same feedback from students over the course of the study. Students in 2007 were told that the questions in the exam would be similar to those presented in the Moodle lessons and those given as team quizzes in lectures and, in fact, some examination questions were taken directly from the lessons and quizzes. Unfortunately, the mean grade for the course was 55%, only slightly better than the baseline average of 52% (Fig. 7.15). Anecdotal evidence (feedback of a random selection of individuals when queried by their lecturer) points to some poor *Kuppi* conducted immediately prior to the exams but it might well be that students did not alter their usual study patterns (in line with their expectations that they would be able to rote learn for the exam) and continued to rote learn answers to past examination papers either in *Kuppi* or through self-study.

7.1.6 Learning Preferences

Despite the negative response to Software Engineering lectures described above, students were appreciative of other elements of the learning environment such as the videos made in 2007 which featured industry representatives explaining how the topics taught in the Software Engineering course were applied in the organisations they worked for.

> Yes. It is valuable. We can get a good knowledge on Software Engineering. Practical video clips are very useful for us to get a better understanding about the subject. It saves our time; it is the easiest way to remember our theory parts.
>
> (Participant, Focus Group 2007)

Significantly more students in 2007 agreed with the statement *After doing this subject, I feel that I understand how software engineering is used in the IT industry* with the difference between the 2004 (baseline) response (56.5% of students) and the 2007 response (73.1% of students) being significant at the P=0.05 level (Fig. 7.16). Given that these video clips were the only additional input to the course directly related to industry, it can be assumed that this result reflects the impact of these videos.

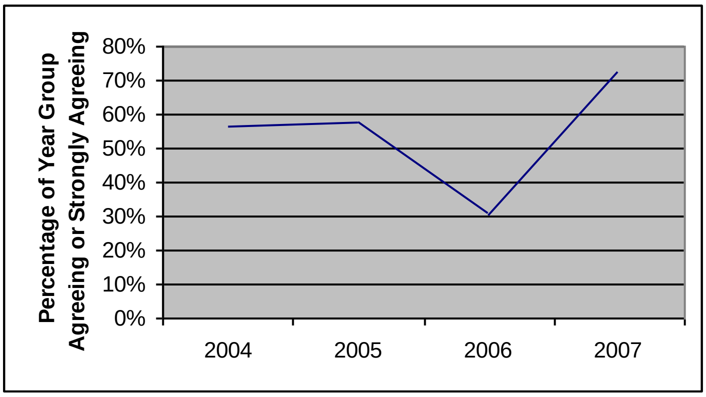


Figure 7.16: Comparison of 2004/2005/2006/2007 student responses to the statement "*After doing this subject, I feel that I understand how software engineering is used in the IT industry*".

The consistency with which students requested more practical and real-world inputs, and the frequency with which they nominated a preference for concrete inputs such as these videos suggested the possibility that a predominant learning preference might be the key to better understanding their response to the learning environments set up in this study. Consequently a small-scale investigation of learning styles was undertaken in 2007.

7.1.6.1 Learning Styles

In 2005, students had found an analysis of their preferred learning styles helpful. In 2007, the exercise was repeated with students being invited to test for their dominant Myers-Briggs personality types as a means of understanding how to work better with others in their team.[98] Results were collected for 98 students (out of 102 enrolled in the course).

Table 7.3 is a map of the preferred learning styles of the group. It shows the group to have a dominant Sensing function hence favoring 'clear, tangible data and information that fits in well with their direct here-and-now experience' (Reinhold 2006, para. 6) and with a preference for the 'inner world of information, thoughts, ideas, and other reflections' (Reinhold 2006, para. 12) – in other words, Introversion. More students have a Thinking preference than a Feeling preference, indicating a 'natural preference for making decisions in an objective, logical, and analytical manner with an emphasis on tasks and results to be accomplished' (Reinhold 2006, para. 7).

Table 7.3: Myers-Briggs Type preferences of FIT students (2007)

ISTJ	ISFJ	INFJ	INTJ	TOTALS
19	**7**	**4**	**4**	**34**
ISTP	ISFP	INFP	INTP	
9	**10**	**2**	**11**	**32**
ESTP	ESFP	ENFP	ENTP	
2	**3**	**3**	**2**	**10**
ESTJ	ESFJ	ENFJ	ENTJ	
7	**14**	**0**	**1**	**22**
37	**34**	**9**	**18**	**98**

The implications of FIT students' preferred learning styles to the design of optimal learning environments is expanded upon in the discussion section of this chapter.

7.1.6.2 Preferred Learning Context

The preferred context for learning in 2007 continued to be the *Kuppi* or study group.

> Moderator: Don't you study alone?
>
> Participant: We can't study alone. So we study with our friends. Some students have a good knowledge on some subjects, so they help others. Actually it is a method of studying. We get a good understanding about the subject matters. This is easier than studying alone. We rarely study alone. Students who stay at boarding houses benefit from this method than us. They have more opportunities than us.
>
> (Participant, Focus Group 2007)
>
> In a Kuppi, a more knowledgeable one comes and explains again near the exams. Maybe just for the sake of Kuppis we get through the exam.
>
> (Participant, Focus Group 2007)

"Participating in *Kuppi*" was rated relatively lowly as a learning activity in 2007[99] compared to other years but this may have been because students completed the Course Experience Questionnaire before the start of the reading week when most

[98] Students were invited to take the informal online personality type test on http://www.personalitypathways.com/type_inventory.html. This informal online test is not an official MBTI (Myers-Briggs Type Indicator) instrument but does give a rough guide to type. It was explained to students that the results would only be a rough guide to their preferred type as a proper MBTI test should be administered and interpreted by a qualified professional.

[99] Participating in *Kuppi* received an average rating of 5.71 pushing it down towards the end of the list of learning activities which students felt had helped them learn the subject.

Kuppi are convened. As in 2006, one of the primary functions of the *Kuppi* continued to be to help students memorize answers for expected examination questions. However, from student comments such as that below and comments made about *Kuppi* in previous years, it is apparent that both *Kuppi* and study groups are collaborative learning environments.

> We can get a better idea about the lesson when our friends explain. Some students can explain theory parts better than lecturers. I think the problem is the way our lecturers teach us.
>
> (Participant, Focus Group 2007)

Changing the approach to the inter-team quizzes of 2006 to encourage students to collaborate in the manner of study groups or *Kuppiya* and to think more deeply about the lecture topic was, again, only partially successful. In many cases teams were unable to answer the questions adequately and those who answered were sometimes unable to express the answer adequately in English.[100] This may be linked with the finding in the previous section which showed most students failing to access the Moodle resources during the semester. Students had been advised to prepare for lectures by reading lessons and doing quizzes online prior to attending. Given that most had not done so,[101] they were having to answer the questions based on the input of the lecture alone – an input which the majority found to be inadequate. However, student comments during focus groups indicated that they felt they benefited from having the lecturer correct their answer or give an alternative answer to the question. The team quizzes in their revised format were rated 6.14 on average ranking them in the lower third of the list of preferred learning activities (Fig. 7.7).

7.2 Discussion

Based on the results discussed above, it can be concluded that the course design in 2007 was far more successful in achieving its goals than that of 2006 in what was effectively the same context. Most of the contextual factors noted in 2006 (such as resentment of the 80% lecture attendance rule, lack of feedback about assignments and uncoordinated scheduling of assignments across the faculty) re-emerged from the data in 2007 with the exception of some stress factors such as time consuming extra-curricular activities and the problems associated with relocating the faculty to the new campus. The constraints on the course design identified in Chapter 4 (such as set assessment weightings, a set textbook, and compulsory lectures) also did not change. However, student perspectives on the course were much more positive with the problem-based assignment regaining its perceived value as a learning activity and as a vehicle for building soft skills.

In order to reduce the course load, some learning activities, which in past years had been important in building skills, were dropped. Losses included the first assignment, which required students to work together to build a web site, and which had helped students to build a strong team identity. Similarly, the second assignment, which had a class presentation as its primary deliverable and was a valuable tool for building oral communication and teamwork skills, was lost. The ability to build skills and team identity or to work through Tuckman's forming-storming-norming-performing cycle (Levin 2005) over a series of team activities was also lost by cutting back to a single assignment. Given that the anticipated gains in terms of reducing perceived

[100] Personal observation.
[101] Feedback from focus groups and pers. comm. from lecturer

workload stress for students did not eventuate, it can be concluded that these losses were not justified.

The conclusion, reached in 2005, that it was simply not possible to develop all the required soft skills in the context of a single subject, needs to be reiterated here. After 2005, the iterations of the design lost the original intent of moving gradually towards a coherent whole which would, in itself, answer the challenge posed in the research question and exemplify a PBL environment which could be implemented effectively in the context of FIT to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills. Instead, changes in the design were made by myself and the course lecturer after analysing and reflecting on each year's findings to answer issues identified from those findings. Successful elements of the design were sometimes not carried forward where they conflicted with other changes. An instance of this was the failure to continue with the first and second assignments in 2006 and 2007 in the interests of reducing the student workload. It was accepted that a new context would need to be found within which the successful elements of the design could be implemented and that this new context would necessarily involve a whole of curriculum approach. This idea is explored further in the final chapter. In the next section, the implications of the findings from the 2007 iteration of the design will be discussed.

7.2.1 Implications for developing teamwork skills

Although students in 2005 were the most likely to feel that the course had improved their teamwork skills, students in 2007 also felt that the course had built their skills and expressed a strong preference for working in a team rather than individually. Their comments in focus groups also indicated that they were, in fact, approaching group work in a team or collaborative fashion. In this section, I will look at the elements of the learning environments in these two years which supported the development of teamwork skills. In 2006, due to a range of factors, students failed to gain a positive experience of teamwork. This, in itself is useful, as conclusions can be drawn about factors in the learning environment likely to work against the development of teamwork skills.

The salient differences between the learning contexts in the three years can be summed up as follows (Fig. 7.17):

- In 2005, lecturer/facilitators with experience of small group work were available to attend team meetings and guide tutorial sessions but this form of support was not available for students in 2006 or 2007;
- In 2005, students were guided to work through a number of teambuilding and team skills building activities. Students in 2006 and 2007 received progressively less orientation towards teamwork because of conflicting demands on tutorial timeslots. Students in 2007 also did not benefit from the teambuilding experience of the first and second assignments from 2005.
- Students in 2006 claimed that they felt they were working under pressure, with conflicting demands on their time, with limited faculty support, and little support for their major assignment. Students in 2005 appeared to be free of extracurricular demands (although overloaded with work for Software Engineering) and to feel secure in the support of their team facilitators. The situation for students in 2007 appeared to be somewhere between the two extremes.

- In 2007, students were able to self-select team membership and thereby avoid the communication problems experienced in 2005 and 2006.
- In 2005 and 2006, the tools used to address the issue of freeloading or social loafing were peer assessment and *viva voce*. Use of these tools did not promote a sense of personal accountability in teamwork. In 2007, the use of the Wiki module led to a student (mis)perception that their individual contributions to teamwork would be assessable. This led, in turn, to higher levels of perceived individual accountability.

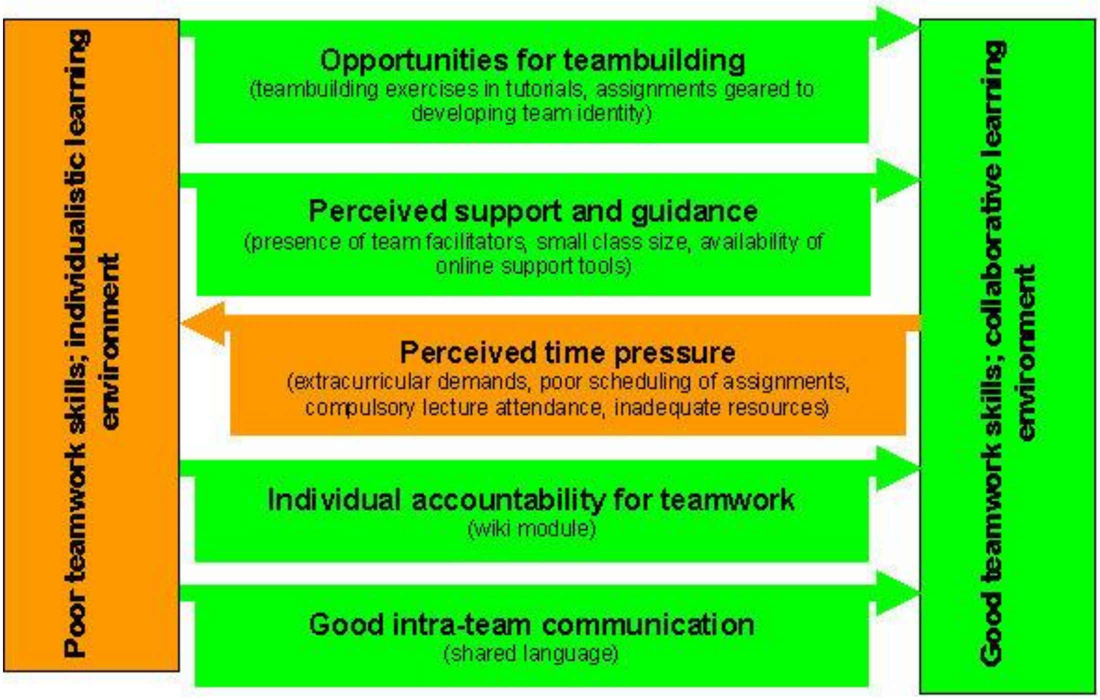


Figure 7.17: Factors contributing to the development of teamwork skills (arrows show what the factor contributes to).

Based on this evidence it would appear that FIT students are capable of developing good teamwork practices without a specific orientation to teamwork and without the support of facilitators provided that they can self-select team membership ensuring a shared language, are adequately supported with appropriate pedagogical tools and provided that an effective answer is found to the issue of social loafing.

Unfortunately the study did not have the capacity to test whether teamwork skills built in the homogeneous environment of friendship networks would be sufficiently robust to withstand the heterogeneous team environments likely to be encountered in the workplace. Heterogeneous teams in 2005 were able to move through the forming, storming, norming and performing stages of Tuckman's model (Levin 2005) with facilitator support but similarly mixed teams in 2006, without the help of facilitators and with minimal orientation to teamwork, encountered significant and largely unresolved problems. This is consistent with research carried out in other contexts. Jaques (cited in Taylor & Burgess 1995), is explicit about 'the central role played by the facilitator in the early stages of development of the group and the shift towards a more peripheral role as the group develops'. O'Donnell (1999, p.227) concurs reasoning that 'It is impractical for teachers to expect that students will make the transition from novice to expert strategies without explicit instruction'. O'Donnell (1999) felt that there was a critical role for the facilitator in teaching students techniques of collaboration (i.e. being a good listener, asking for help when needed, how to generate good questions, when to elaborate on one's assertions and when to explain how one arrived at a particular conclusion). Other studies investigating the introduction of PBL in South Asian contexts (Khoo 2003; Jayawardana & O'Donnell 2007) also identified a critical role for facilitators.

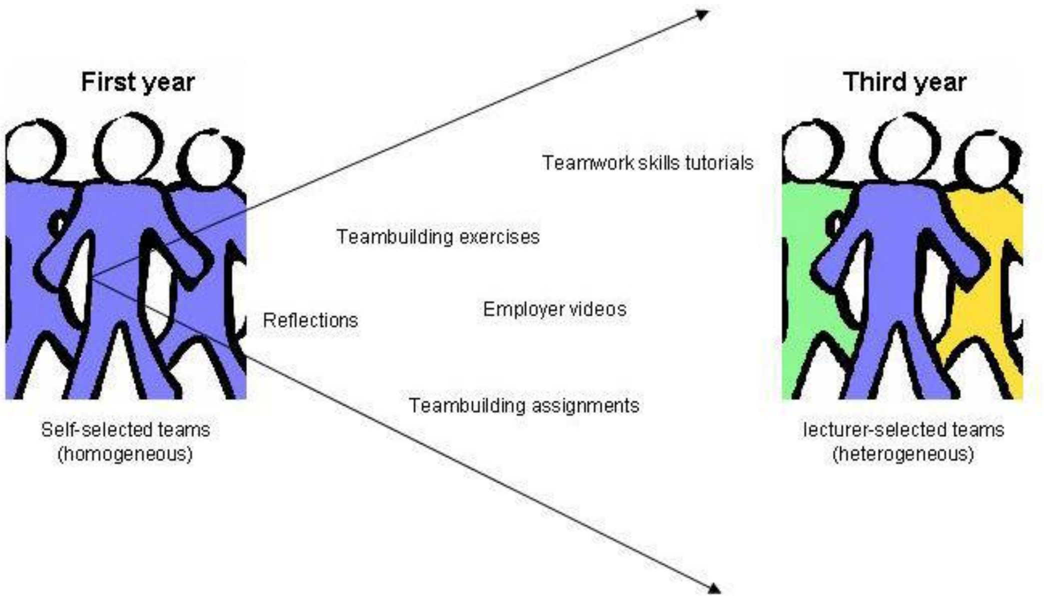


Figure 7.18: Proposed approach to building teamwork skills over the course of the degree

It may well be desirable to allow students to self-select teams early in their university careers to provide them with an experience of successful teamwork reinforced by opportunities for reflection. In subsequent years they could be led into situations that more closely approximate that likely to be encountered in the workplace with more heterogenous teams[102] selected by lecturers but scaffolded by the range of support mechanisms provided to students in the first year of this study (2005) (Fig. 7.18). Once again this points to the inadequacy of attempting to change attitudes and behaviours in a single course subject.

The problem with social loafing – particularly acute in 2006 but present throughout the study – was only resolved once students thought that their individual contributions were being noted and counted for assessment. This happened inadvertently as the result of using the Wiki module in Moodle as a platform for team collaboration. While 50% of students in 2007 said that they thought that they should be graded based on their individual contribution to team products (Fig. 7.5), previous attempts to have students take responsibility for assessing the contributions of their team mates had been largely unsuccessful. The Wiki solution was popular since the

[102] In order to promote collaborative learning and provide adequate opportunities for exploratory talk, it is important that the teams thus formed, while heterogeneous, share a common language.

evidence was provided by the software rather than by team members. This response would appear to deny a meek acceptance amongst Asian students of "equality of reward distribution among peers" in the interests of collectivist harmony as suggested by Dimmock (2000) but, at the same time, indicate an unwillingness to jeopardise team harmony by personally contributing to differentiation of team marks between individuals. This is similar to the findings of Papinczak, Young & Groves (2007) conducting research at the University of Queensland (UQ) (Chapter 4). It is possible that, like the students at UQ, students in this study were concerned about their relations with their peers to such an extent that they similarly did not wish to give negative peer feedback. This is consistent with their collectivist culture and the culture of helping each other to do assignments and study for examinations.

In retrospect, there were a number of other strategies which might have worked well to reduce social loafing (both voluntary and involuntary) but which were not attempted. For instance, while students might have been reluctant to award marks to their teammates, they may have been prepared to provide qualitative feedback (i.e. in the form of a team leader/team member skills profile) particularly if there was an opportunity for the recipient to act on this feedback and improve their profile. Given the importance Sri Lankan employers place on teamwork skills (Madurapperuma & Macan Markar 2006), a skills passport of this nature could be expected to be of interest to prospective employers and might have motivated students to make more of a contribution to team building, for instance by helping less able team members to perform rather than merely discouraging their contributions, by making fair contributions to the workload, and by engaging in team discussion and collaboration. A number of studies have found peer feedback of this nature to be a useful type of formative assessment (Roberts 2006; Wen & Tsai 2006).

7.2.2 Implications for developing problem solving skills

In 2007, the continuous assessment load was cut back to a single assignment which required students to meet a client, interview him and produce an SRS for a new computing system for his business. The assignment was generally well done (continuous assessment results cited above) and excerpts from focus group transcripts quoted above indicate that students appear to have approached it as a team. Students in 2005 were also successful in designing an SRS for a real world business even though they had to find and adapt their own templates compared to students in 2007 who were given a template and walked through it using a real world example. The situation in 2006 was completely different. Students appeared to have little idea of how to approach the assignment, even after being given templates, and handed up extremely poor work marred by plagiarism. Freeloading became a serious issue with many students avoiding involvement in the assignment purportedly because they could not understand it.

In 2005, it was concluded that, in undertaking problem-based assignments, FIT students were probably working in what Vygotsky termed their "zone of proximal development".[103] Jarvis et al. (2003) noted Vygotsky's caution that students working at the limits of their potential generally require scaffolding to help them undertake tasks. In 2005, this scaffolding was provided by group facilitators. In 2007, scaffolding was provided by helping students work through a similar example in tutorial sessions prior to undertaking the actual assignment. Students in 2006,

[103] This 'zone' is the difference between what a learner can do alone and what he/she can do with assistance.

without any scaffolding other than the provision of the SRS template, found the assignment too challenging. As the national selection processes of the UGC effectively control for student ability,[104] it is likely that the difference lies not in the student body but in the scaffolding and support provided within the course. Scaffolding of PBL is essential for these students with the study pointing to two viable alternatives: supporting teams with facilitators or providing students with a concrete and closely related example.

As student perceptions of high workload stress were a constant through all years of the study (apart from the 2004 baseline study) regardless of the actual load, I can only assume that the perception related more to external factors than to actual workload in Software Engineering - with the probable exception of 2005 where the workload was very high. One possible factor was a lack of coordination between FIT lecturers on assignment due dates such that many major assignments fell due in the latter part of the semester which was when focus groups were held. However many other reasons were cited by students such as compulsory lecture attendance and extra-curricular time demands negating their ability to manage their own time.

7.2.3 Implications for communication skills

FIT students face the challenge of having to learn the concepts of information technology at the same time as learning the language in which these concepts are being presented. This was even more difficult for this final group of students as they missed out on the English language foundation course in their first year. Fortunately, in designing a learning environment to support them, it was possible to draw on a wealth of research done in the area of multilingual learning. Accordingly, online tools were prepared that could be used by students to help them prepare for their lectures which would not only explain the concepts of the course but model the language of discourse. Through a series of video presentations, students also had the opportunity to hear the language of Software Engineering being used by practitioners in the field. At the same time, students were allowed to self-select team members to provide an opportunity for exploratory talk as they worked on assignments and/or answered quiz questions in lecture sessions.

Unfortunately, the findings suggest that students generally did not take advantage of the tools available to prepare for lectures except where time was made available in tutorial sessions. The extent to which this was due to assignment overload, the assessment-driven culture of the student body, or immaturity in taking control of their own learning is debatable.

Whilst working in their mother tongue may have provided an opportunity for exploratory talk, the achievement of CALP (Cognitive Academic Language Proficiency) in English requires students to move from discussing concepts in their mother tongue to discussing them, first informally and then formally, in English. Opportunities for discussions in English were limited in 2007 – a deficit recognized by the students themselves who came up with a range of suggestions for remedying it (from tutorial discussions on topics related to the lecture to more opportunities to meet industry representatives). In 2005, students had the opportunity to practice discussing software engineering topics informally in English in facilitated team meetings and then formally in class presentations. In 2006, students used formal

[104] Student numbers across all faculties remained constant from 2006 to 2007 making it reasonable to assume that similar z-score cutoff levels were used in student selection.

English in presentations and in the *viva voce*. In 2007, opportunities to practice the use of the terminology of Software Engineering in more formal contexts were only available through team presentations to the class and, for selected people, when meeting the client. This needs to be acknowledged as a design flaw which could have been remedied by expanding the level of formal interaction with industry. Recently FIT has instituted a system of industry mentors (Dias, D. 2007, pers. comm., November 29) to provide students with insights into the industry and reinforce the value of soft skills. It is hoped that this initiative will provide an opportunity for formal and informal discourse in English.

Given that computers in the campus laboratories were all equipped with multimedia tools, it would also have been possible to ask students to verbally paraphrase sections of topics covered in lessons to practice using technical terms correctly. Coelho (2004) notes that paraphrasing or summarizing is a challenge for students working in a second language who feel far more comfortable copying verbatim from texts than to risk making a mistake with grammar. This is almost certainly the case for Sri Lankan students many of whom, as we have already described, regard English as a *kaduwa* (sword) likely to trap or hurt them.

A number of other good suggestions for the improvement of the Glossary and Lesson online modules were made by the students themselves and were described above.

7.2.4 Implications for Learning

Knowledge in the field of information technology is constantly changing. Employers need graduates who, as independent learners, have the capacity to keep up to date. This expectation clearly guides the approach of some FIT lecturers who believe in providing the fundamentals for their students who are then expected to build on these fundamentals by themselves.

> In my first lecture I say, “This area is too broad. I’m not going to teach more than 30-35%. But I want you to cover 100%.” So the rest is self-learning. But I guide them, I give them enough homework and I give them feedback when they submit their assignments back to me. So this is my approach. And they know that my testing is going to be based on their assignments...Yes, that is true when they come to us out of school they have been kind of spoon fed and we want them the other way around – almost overnight like – so that is why I structure the assignments carefully – each one builds on the other. I’m just a guide not a teacher – I make sure they understand that.
>
> (Senior Lecturer, 2005)

The issue raised by this lecturer of scaffolding the transition from passive learning to independent learning is an important one. If students are expected to make the transition by themselves, it can be too challenging.

7.2.4.1 The need for an orientation program

Whether or not it is necessary to provide an orientation to independent learning as a form of scaffolding has been the subject of an ongoing debate in the literature with different tertiary education providers taking different stances on the issue. In preparing a tertiary course in social work, Taylor & Burgess (1995) considered many arguments both for and against orienting students to group work and independent study before deciding to include an orientation program in their course. Despite the fact that a number of researchers had pointed to ‘an apparent paradox implicit in the notion of teaching students self-directedness’ (Boud cited in Taylor & Burgess 1995, para. 1) and Freire (cited in Taylor & Burgess 1995, para. 4) who noted that such teaching “undermines and disempowers the learner”, Taylor and Burgess decided that an orientation would be beneficial for their students many of whom were adult learners returning to formal study after a long absence. Follow-up monitoring of the course endorsed their decision. Closer to home, a study by Khoo (2003) of Asian medical schools implementing PBL, cited a number of institutions in the region making a similar assessment,

> A report by Huda and Brula on a Pakistani medical school that had begun to implement PBL indicated that running an introductory course on study skills was important to guide students from a traditional system of education to the student-centred, PBL curriculum in the medical school. The general feeling of faculty members in this case was that students who had participated in this introductory course were able to perform better than those who had not taken the course. Similarly, Chhem et al. (1999) have also reported on their experience in training medical students in Singapore for PBL as a new method of learning. They found that it was very useful to run a workshop that introduced the students to the theory of PBL and a practical practice PBL session before term actually started (Khoo 2003, p.402).

Taylor and Burgess (1995) structured their orientation program around group meeting skills, time management, learning styles, and group work styles and what they mean for the group. In 2005, a similar approach was used in this study where students worked through role plays and discussions of topics ranging from group meeting skills to conflict resolution. Students were placed in teams based partly on their preferred team roles[105] and were asked to consider the implications of these preferences for how they would work together. In 2006 and 2007, they also considered their learning styles[106] and were asked to consider how knowing the preferred learning styles of their team mates would make working together easier and more effective. All of this could easily form the basis of an orientation program.

7.2.4.2 Influence of learning styles

Student feedback throughout the study indicates that most would welcome a move towards a more independent learning style. In the successive focus groups conducted throughout the study a recurring theme was students' desire to take more control of their own learning. Self-study was consistently rated as the most useful learning activity undertaken during the course. This finding should not be misinterpreted or taken as a rejection of the learning resources provided by the university. For a start, FIT students acknowledge that they rarely study by themselves preferring to study in groups or through *Kuppi*. Students in the Software Engineering course also identified a range of resources that they would like to be able to draw on. These resources included :

1. Assignments that required application of knowledge rather than cut-and-paste solutions;
2. Readable course notes rather than textbooks which were difficult to understand (such as the Software Engineering course text);
3. Lecturer input in the form of mentoring and guidance, particularly for the annual projects;
4. Resources and experiences that could help them improve their English and communication skills. Examples included class presentations, meetings with

[105] This was the "What sort of Team Player Are You?" online quiz from Queendom.com based on the Belbin, Margerison-McCann and MTR-I role typologies

[106] In 2006, students used the Vark online questionnaire (www.vark-learn.com) to establish their preferred learning modality - Visual or Aural or Read/write or Kinesthetic – and in 2007, they used a personality profile based on MBTI.

industry, opportunities to practice, and online resources such as the Moodle glossary and lessons;

5. Teamwork experience with group responsibility and individual accountability;
6. Lecturers who could explain the concepts of a subject through practical examples and drawing on their industry experience.

The short analysis of preferred learning style conducted in 2007 also demonstrated FIT students' preference for the concrete and the immediate in the presentation of new work. That FIT students should prefer to interface with new knowledge through the concrete and practical, is not unexpected. Arons (cited in O'Donnell 1999, p.220) advises that the process of learning new concepts in science should always proceed from the concrete to the abstract 'especially in light of the difficulties students experience in trying to apply concepts acquired in their abstract form to unfamiliar concrete settings'. Redish (cited in O'Donnell 1999, p.220) reinforces this explaining that 'New knowledge is most efficiently acquired in a known and understood context'.

Hills (2003) sought to apply the research that has been done on the Myers-Briggs MBTI learning styles to the design of eLearning environments. He determined that most people tend to have a preference for the real and immediate (a dominant sensing function) similar to FIT students. Since most FIT students have very limited knowledge of the context of information technology prior to starting their course, they are likely to appreciate the opportunity to experience something first hand, as with their practical assignments, or even second hand, in the form of anecdotes told by a lecturer from his/her own personal experience. This will provide them with a means to ground the theory they are expected to learn by providing it with a practical or concrete anchor. In fact, their very criticisms of Software Engineering lectures are often delivered along with pleas to do just this – to explain the conceptual in terms of the concrete.

For sensing learners, according to Hills (2003, p.126), 'Descriptive practical examples of real world events will be appreciated more than sections of theoretical explanations and ideas'. He suggests that video segments may provide this real world input. In fact, video recordings of industry representatives explaining how they apply the principles of Software Engineering in their own organizations, were well received by FIT students as were the videos highlighting the need to develop soft skills.

Hills (2003) presented the following breakdown of preferences based on the MBTI scores of 4622 individuals from the UK and US. In Table 7.4 below, I contrast these with the stated preferences of Software Engineering students in 2007.

Table 7.4: Learning preferences of FIT students compared to US & UK population sample based on MBTI scores

	US & UK (n=4622)	**FIT, Sri Lanka (n=98)**
Sensing (taking in information)	74.4%	72.4%
Feeling (making subjective decisions)	57.8%	43.9%
Intuition (inferring and connecting ideas)	25.6%	27.6%
Thinking (making objective decisions)	42.2%	56.1%

Adapted from the table, "Distribution of Dominant and Secondary Functions" (Hills 2003, p. 117)

The finding that 56% of the students in this study have a preference for a thinking function compared to a UK/US average of 42%, may well be due to three quarters of FIT students being male. A thinking preference is over-represented in the male population (Hills 2003). Nonetheless, the dominance of the thinking preference in the student population means that there is a preference for logic and order - a structured course.

7.2.4.3 Student Pedagogical Preferences

The Dean of the Faculty in 2005 expressed a concern that Sri Lankan students were too assessment-driven.

> It is a problem, not only for our faculty, it is a problem for the entire university system, that these students are used to learn just to sit for exams. Their learning process up to the A Levels is only to pass the exams so they learn a lot of material from the books, do past papers, etc with the sole objective of trying to pass an exam. And when they come to the university, it is extremely difficult to try to change this attitude overnight so what we are trying to do is to, slowly, make them realize that learning is not just a process that culminates in sitting for an exam but that learning is a process that can be used throughout their lives, in the industry and in other areas as well.
>
> (Dean, Academic Staff Interview 2005)

In fact, students in focus group interviews consistently claimed to reject rote learning for examinations. *Kuppi* sessions did involve rote learning answers to questions on previous exam papers and students did routinely memorize their inputs to class presentations (and *viva voce)*. However they also appreciated assignments which required them to apply their knowledge and which had the nature of professional preparation as well as lectures, notes, videos and other resources that helped them to understand the course rather than merely memorise it. Moreover, they took measures to acquire practical/professional skills where they felt that the university had not prepared them adequately (e.g. the case of Java courses taken externally described in Chapter 6). I feel that such things can be taken as evidence that they do, in fact, recognise that learning is important beyond exams. It was not possible to determine the extent to which the prevalence of rote learning and plagiarising is related to limited English language fluency, lack of time to study in a curriculum crowded with assignments and lectures, and expectations generated by the assessment system itself – as claimed by the students – without a significant change in the learning context.

Of course this situation is not unique to Sri Lanka. Aldred et al. (1997, p.12), investigating implementing PBL in traditional professional development courses in Australian universities, report that:

> The large quantity of knowledge required for professional practice has led to the undergraduate curriculum being viewed from an increasingly instrumentalist perspective and has reduced the capacity for critical thought amongst graduates. A behaviouristic, psychometric approach to learning and assessment has emerged. This has led to excessive, unrealistic workloads for students which are intellectually unchallenging, encourage passive learning and do not motivate the student (Jones 1990). According to Heath (1990), many universities continue to rely on passive transmission, memorisation and regurgitation as a means of pedagogy. Information obtained in this way is easy to forget and difficult to apply to new problems.

The challenge for FIT, as for universities worldwide, will be to change the learning environment to provide a context for learning in a way that interventions on a minor scale, such as the one in this study, can never hope to do. However, what this study has achieved is to:

1. demonstrate that FIT students are capable of (and prefer) employing higher order learning skills if the learning activity is professionally meaningful and appropriately scaffolded;
2. show that students have a strong drive to succeed in their professional field which readily translates into motivation to develop soft skills once they are aware of employer expectations in this area;
3. test the effectiveness of a range of activities and eLearning tools as support mechanisms for the development of soft skills as well as academic content.

It has also shown that FIT students learn best in both group contexts and when faced with learning activities which require them to gather and apply knowledge. Covering the syllabus through lectures does not guarantee meaningful assimilation of knowledge - although this does not preclude lectures, if appropriately geared to the learning style of the students, being effective learning resources. Dixon (2000, p.41) explains that,

> In the past, the emphasis was on "just in case" knowledge - the curriculum was designated to provide the student with a storehouse of information that could then be drawn on during the student's professional career. Given the pace of change in all work environments, such an approach is neither practical nor desirable. Instead the focus will have to shift to “just in time” knowledge, which means that students need to be able to access new information, for example, from the Worldwide Web, as and when they need it.

However, learning activities which build the skills for acquiring “just in time” knowledge require more contact time and are more resource-intensive than traditional lectures and will necessarily compromise the breath of syllabus coverage bringing us back to lecturer concerns that,

> There the problem may be that when we are trying to introduce things onto that side, always the fear is there that the value attached to giving knowledge may go down. That problem is there. And that possibility is also there. The knowledge may come down to some extent and we have to make sure that that is minimal especially in the high tech areas.
>
> (Senior Lecturer, Academic Staff Interview 2005)

7.3 Conclusion

This chapter has presented and analysed the results of the final year of the study. In drawing conclusions for how a PBL approach can be implemented effectively in FIT to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills, I have compared results from a trial of PBL in one subject in 2007 with results from a similar trial in 2005 and 2006 and from a baseline study conducted in 2004. From these conclusions it is possible to identify some elements of an optimal learning environment for FIT students given the learning goals specified in the research questions for the study. This optimal learning environment is described in the next, and final, chapter of this study and used to generate a framework for professional education and skills training which can be tested beyond the limited context of the current study. Building on the conclusion that it is not possible to achieve the targeted learning goals in the context of a single subject, a proposal is made for a reworking of syllabus objectives across the curriculum such that the desired soft skills are developed progressively across the three years of the FIT degree program. The feasibility of this strategy is considered against the evidence about the learning environment collected during the study and a recommendation is made for a field test of the model.

CHAPTER 8

Conclusions – A Framework for Professional Education and Skills Training in Sri Lanka (PESTS)

In this final chapter, I draw upon the results and conclusions presented in Chapters 4 – 7 to address the research questions posed in the introduction.

In answering the first of these questions,

> *How can a problem-based learning approach be implemented effectively in FIT to provide students with the opportunity to develop problem-solving, teamwork, communication and independent learning skills?,*

the context and findings of the study are used to identify parameters of an optimal learning environment from which some broad recommendations for the FIT curriculum are derived.

From this foundation, a framework for Professional Education and Skills Training in Sri Lanka (hereinafter referred to as the PESTS Framework) is derived. This framework is the *theoretical framework which could be applied beyond the limited context of the study,* referred to in the second research question (Chapter 1).

The generation of a model or framework is consistent with the tenets of design-based research where there is an expectation that field-based research will generate models of learning.

> Importantly, design based research goes beyond merely designing and testing particular interventions. Interventions embody specific theoretical claims about teaching and learning, and reflect a commitment to understanding the relationships between theory, design artifacts, and practice……The intention of design-based research in education is to inquire more broadly into the nature of learning in a complex system and to refine generative or predictive theories of learning. Models of successful innovation can be generated through such work - models, rather than particular artifacts or programs, are the goal (cf. Brown & Campione, 1996) (DBRC 2003, p.6-7).

8.1 Reflections on effective and ineffective approaches

While the study was successful in identifying elements of a learning environment within which PBL could be effectively implemented to promote skills development, it was just as successful in identifying what would not work.

First and foremost, I concluded that it is simply not possible to build teamwork, communication, problem-solving and independent learning skills in one semester and certainly not all in the same semester. Having initially tried to do just this, in the first year of the study, the research team realized that we were guilty of sacrificing the quality of the learning experience we were providing for the students in an effort to "cover" all of the soft skills that had been identified from the employer survey. Having been critical of curriculum designers whom we felt sacrificed student understanding by trying to cover too much content in the FIT syllabus, we had ourselves succumbed to the same temptation. The educational experiences of FIT students prior to university entry have not nurtured any of the targeted skills. Expecting students to be able to develop such skills in a 13 week semester timeframe is simply unrealistic. Consequently, after the first year of the study, I satisfied myself with piloting approaches to helping the students develop selected soft skills which could, if proven successful on a small scale in the current study, potentially be scaled up for application over the whole three year curriculum.

Secondly, almost half of the year group in 2007 had some level of difficulty with doing the course in English (Table 7.1). This limited the effectiveness of any other element of the learning environment including exercises in problem-solving or skills development – particularly where the support material was to be provided as written documents. I realized that it was critical to target the development of English language fluency as a fundamental aspect of the instructional design and to elect to use, where possible, video and / or audio resources rather than written documents to do this which is also consistent with the preferred learning styles of the majority of students. FIT students need to practice their spoken English both in formal and informal settings. There were not enough opportunities for this built into the course design.

Thirdly, the traditional lecture presentation which guides students through the concepts of the field in a logical progression, is inadequate in this context. Many FIT students do not have adequate English skills to follow a presentation using words and terms deemed appropriate at the tertiary level for native English speakers. They also do not have enough prior exposure to the industry or even to information technology in general to allow them to assimilate the theories of software engineering without being provided with concrete examples and illustrations. The majority of FIT students have a dominant sensing function in their preferred learning style which makes it easier for them to assimilate concepts firmly grounded in practical examples. There is an important role for the lecturer to play in providing these concrete illustrations of theory or stories from their own personal experiences and thereby guiding students through the building of mental structures within which the concepts of Software Engineering can be assimilated. It is a limitation of this study that this never happened and, as such, students resorted to rote learning. Across all years of the study, between 50 and 70% of students continued to claim *To do well in this subject, all you really need is a good memory* (Table 7.2). Lecturers also have the capacity to make the concepts of the course more accessible to students by using a simplified English vocabulary, visual aids and gestures, frequent repetitions and summaries, speaking slowly and clearly, and checking often for understanding in line with the practices of Sheltered English, Sheltered Content Instruction or SDAIE (Specially Designed Academic Instruction in English).

Lastly, the students involved in this study were observably assessment driven. They claimed that this was because of a number of factors in the learning environment which did not allow them to take control over their own learning. It was not possible within this study to test this claim by changing the elements of the learning environment referred to (i.e. to make lecture attendance voluntary, to ensure that all lecturers gave a fixed assignment schedule at the beginning of semester, and to guarantee reasonable availability of resources particularly computer networks and Internet access) and to thereafter observe student response. However, I would argue that, in the absence of any level of control over such factors, it would be difficult to take control of one's own learning and, given this, adopting an approach of doing work only if assessable and studying only what one could expect to be examined is a reasonable survival strategy albeit a poor learning strategy.

8.2 Parameters of an optimal Learning Environment

Proponents of design-based research claim that it is the extent to which a design is able to effect changes in the context, that the theory informing the design is valid.

> In contrast to other methods focused on producing theory, the most radical shift proposed by design researchers may be the requirement that inquiry involves producing demonstrable changes at the local level. Design-based researchers not only recognize the importance of local contexts but also treat changes in these contexts as necessary evidence for the viability of a theory. Design-based research that advances theory but does not demonstrate the value of the design in creating an impact on learning in the local context of study has not adequately justified the value of the theory (Barab & Squire 2004, p.6).

The various iterations of the design in this study did effect change in the context - even after significant changes occurred in the context itself in 2006. Hence it is possible to derive a number of indicators as to the parameters of an optimal learning environment drawing on instances of demonstrable change.

Firstly, student feedback is fairly conclusive in indicating that the best learning environment for FIT students is a collective one. From the analysis in Chapter 7, it is also apparent that a group environment where the members share a common mother tongue provides the best opportunity for exploratory talk leading to collaborative learning and the necessary foundation for building simple English and domain literacy. It would also allow lecturers to build code-switching techniques into their teaching repertoire (at least for Sinhala-speaking groups as there is only one Tamil speaking lecturer on staff at the time of writing).

Self-selection of team membership was found to have benefits for students new to team work but tended not to result in them experiencing the sorts of group dynamics best known from Tuckman's (1965) model of forming, storming norming and performing cycles. According to Tuckman's model (Levin, 2005) teams go through stages which involve role negotiation and interpersonal conflict before they start to perform as a team. There was much more evidence of changing attitudes towards the team and interpersonal conflict in 2005 and 2006 than in 2007 and it might be expected that students would have learnt from this experience. Apart from ensuring that team members shared a common language, the more homogeneous team structures generated through self-selection of membership more frequently resulted in a positive experience of group work, fewer incidences of social loafing, more collaborative learning, and better insights into appropriate team roles. Student perceptions of individual accountability through the use of the Wiki platform also resulted in a better teamwork experience for most. While it is important for students who will work in teams throughout their professional life to experience the group dynamics of heterogeneous teams at some stage in a professional preparation course, it needs to be borne in mind that FIT students have not usually experienced team work prior to university. Structuring a learning situation to provide a positive experience of teamwork on which they reflected, worked well to establish a good understanding of team roles and the benefits of working and learning collaboratively.

FIT students also have a strong drive to know more about industry and to accumulate skills that will help them succeed in their professional careers. They consider gaining industry skills as important as getting good marks. This means that learning experiences which provided them with exposure to industry or which were discerned as building professional skills, were highly regarded. Examples from the current study included the industry videos and the problem-based team assignment. The problem-based assignments were also positively regarded as they were seen as challenging and requiring the application of knowledge. Obviously it is impractical to teach the entire course through assignments without adjustments to the syllabus and the mode of assessment (especially as students already claim to be overloaded with continuous assessment). However it is relevant to look at the elements of their problem-based assignments which caused students to consider them such useful learning exercises.

Essentially these were:

- Assignments were done as team work but with individual accountability;
- Assignments were similar to tasks students could expect to undertake after entering the industry and were therefore appropriate professional preparation exercises;
- The nature of assignments was such that it was not possible to cut-and-paste answers off the Internet or from texts. They required the use of higher order learning skills such as analysis and synthesis.

e-Tools such as the glossary, lessons and quizzes were used successfully to scaffold the learning experience although these were more effective where they were made available to students in formal contact time. Where facilitators were available to work with student teams in the first year of the study, they were very effective in scaffolding the learning experience. However, in later years, where it was not possible to provide teams with individual facilitators, a similar level of support was successfully provided through learning activities conducted in a large group setting with roving facilitators. Stepping students through the template to be used to do the final assignment and the construction of concept maps, built their confidence as effectively as knowing that they had a facilitator on hand to guide them. The experience of critiquing demonstration presentations in a similar setting was sufficient incentive to ensure that teams helped each other outside class to practice presentation skills.

On this basis, and in the light of what has been discussed previously, the following elements of a learning environment for FIT students are put forward to address the first research question (i.e. how to make effective use of a PBL approach to support student development of teamwork, problem-solving, communication and independent learning skills).

The learning environment should be:

- Based on team work which uses some mechanism of ensuring individual accountability to discourage freeloading (i.e. a team presentation with question-and-answer sessions, a team quiz where individual answers are counted towards team results, or online traceability as through a Wiki).
- Teams are initially self-selecting to provide a positive experience of teamwork that can be reflected upon to build student appreciation of the value of collaborative work and learning and effective team roles. The structuring of heterogenous teams in subsequent years will provide opportunities to experience group dynamics such as students can be expected to encounter in the work place.

- Uses a PBL approach to problem-solving which can either be facilitated or alternatively modelled in large class settings with the assistance of roving facilitators.
- Uses assignments as learning tools both to build conceptual understanding and soft skills. Effective assignments are practical, industry focused and require the application of higher order learning skills.
- Assignment work is supported by individual team facilitators or, in a large class setting, by learning exercises to help build student confidence and ability to take on the task at hand.
- Is supported by lectures which emphasise helping students to build the mental structures within which theory can be assimilated and which provide concrete examples of application of theory rather then simply covering the content. Lectures should be supported through the use of visual aids including videos.
- Provides students with the time, opportunity[107] and incentive to self-study - including the use of eLearning tools - through the semester rather than only in the lead-up to exams.
- Fosters rather than assumes the pre-existence of time management skills.
- Builds English language fluency as well as CALP through adopting the principles of sheltered instruction, the effective use of e-Tools and providing opportunities for practice.
- Provides space within the curriculum to give students the opportunity to control their own learning.
- Is assessed in a style consistent with the learning exercise itself. For example, if learning exercises emphasise the use of problem-solving skills and mastery of the language of discourse, short answer and essay-type questions will be more appropriate.
- Provides for gradual development of soft skills over the three years of the degree program.

Naturally, structuring learning experiences that meet these conditions, will require more preparation and greater input of staff and other resources, notably access to computer laboratories and tutorial rooms or meeting spaces. Fortunately, the Faculty has commissioned the building of a new premises which includes in its design ample provision for small group meeting spaces. Structuring appropriate learning experiences is also likely to limit the scope of the content that can be covered – an issue identified in the previous chapter.

These recommendations for an optimal learning environment are summarized in the form of a concept map (Fig. 8.1). The recommendations could be applied with to all FIT subject areas and I believe that the argument can be made that, in a professional preparation course for an industry based on teamwork and the resolution of problems, the learning environment would indeed be appropriate for all subject areas.

[107] However, it is my view that providing time and opportunity in itself is probably not sufficient if the incentive to use the time and facilities provided to complete assignments or other work is stronger than the incentive to self-study.

8.2.1 Explanation of the Concept Map

The Concept Map (Fig. 8.1) shows the small group or team at the heart of the learning experience. The main role of the facilitator, who attends increasingly fewer group meetings as the team develops its identity, is to model the language of the discipline and to promote collaborative learning within the team. Resources include videos and guest lecturers from industry to provide technical inputs but, more importantly, build industry awareness, and online materials for self-study. The learning environment should provide students with the opportunity to develop their formal and informal communication skills. Teams should be challenged to produce team products which require higher order thinking skills and exercise the sorts of problem-solving skills they will need in industry. There should be team responsibility but individual accountability for team products. Summative assessment should measure the same skills being promoted through the remainder of the course.

The founders of FIT may well have had a similar learning environment in mind given the emphasis on practical application of knowledge throughout the course and the inclusion of a broader knowledge base than most other computing degree courses in Sri Lanka, as noted below:

> Interviewer: Your Dean has said he wants FIT graduates to be leaders in IT. Do you agree and what do you do to help your students develop leadership qualities?
>
> Lecturer: In Sri Lanka a leader should have other qualities as well – the technical knowledge is not enough. They have to be application orientated [by which he means they need to be able to apply the technical knowledge]. That is why every year we do a project. The idea is that they have to put everything together and do a project. In the third year this gives them an idea of what they can do [when they graduate].
>
> Interviewer: What are the benefits of doing a project?
>
> Lecturer: A project is actually a practical way of implementing what they have learnt. They should be more practical. From the day that they come here, we give them assignments, we give them problems to solve. So that is the practical way; there is no point to learning just theory. Actually the mathematical modeling part has been completely removed from our curriculum. Here they only learn how to apply things that already exist.
>
> (Senior Lecturer, Academic Staff Interview 2005)

> At the moment, I think that, compared to the other faculties we have gone on this [skills training] route much more, because we had a certain amount of advantages and we had the will to do it also, and this particular course is also different because we had this built in from the beginning like, we were not thinking in terms of only technical, only mathematics, we had considered the other areas to be taught like the social aspects of IT, ethics, management, projects that sort of thing so we had the advantage which the others might not have had.
>
> (Senior Lecturer, Academic Staff Interview 2005)

This study has identified and developed instances of an extensive toolset which can be used to scaffold the learning environment described by the concept map above (Fig. 8.1). These tools have been described through Chapters 4-7 and are summarized below. What is required beyond this is a reworking of syllabus objectives across the curriculum such that the desired soft skills are developed progressively across the three years of the degree program. This would be a significant departure from the current situation where lecturers act in a largely autonomous manner with some guidance from senior lecturers. It presupposes a common commitment to the need for graduates to have soft skills as well as technical knowledge and an acceptance that all educators have a role to play in helping them to develop these skills.

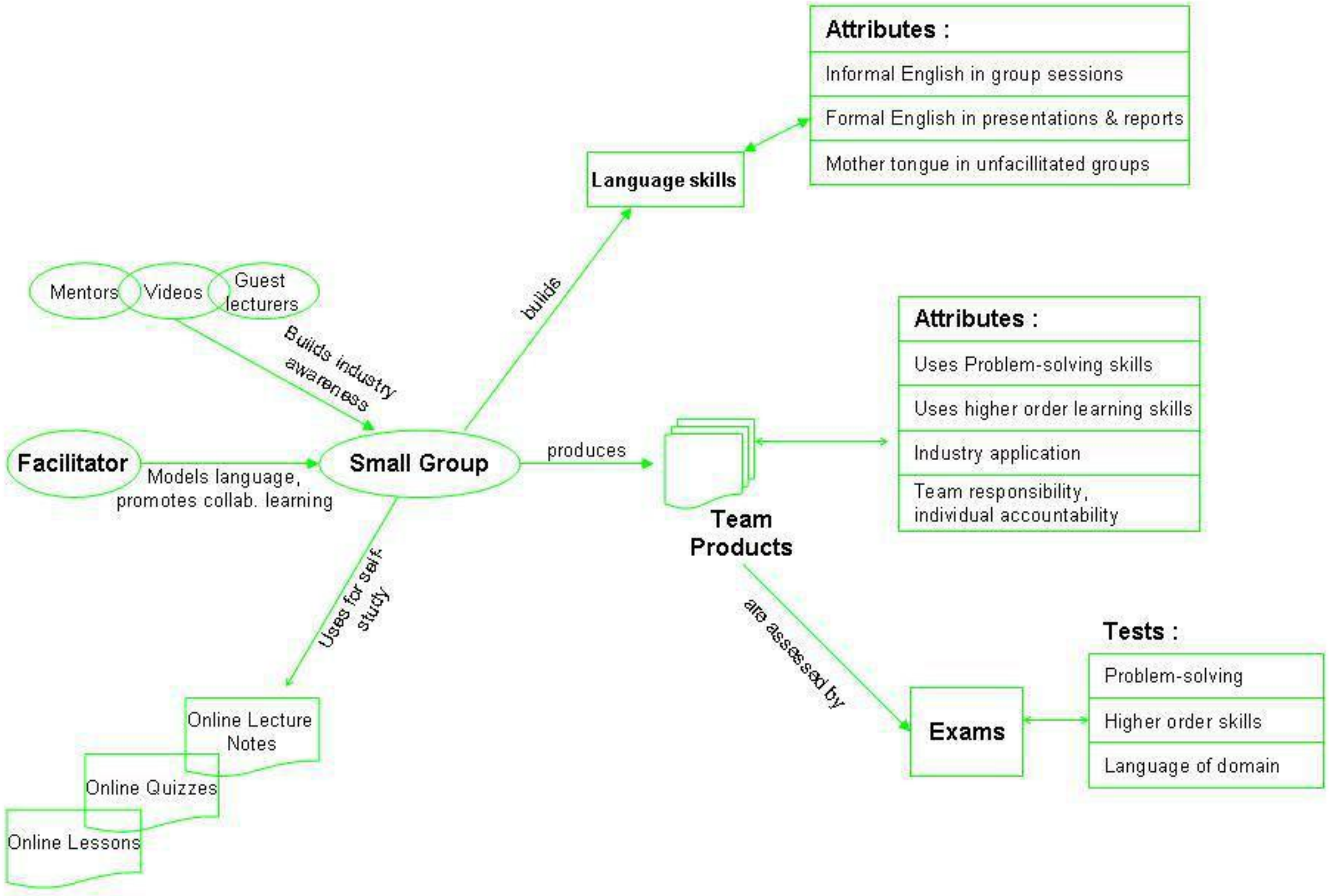


Figure 8.1: Parameters of an optimal learning environment for FIT students

8.3 PESTS Framework

From the experience gained in this study, it would appear to be ill-advised to try to graft the development of soft skills onto the existing framework of autonomous units of study or to rely on the uncoordinated efforts of individual lecturers who happen to be committed to the importance of such skills. To take this study as a case in point, initially it was argued that Software Engineering was a logical place to develop teamwork, problem solving and communication skills since Software Engineers are problem-solvers who work in teams and interface closely with clients such that effective communication is a key skill. However, the extent to which such skills can realistically be developed in a 13-16 week[108] semester unit while simultaneously addressing mastery of the language of discourse and the underlying concepts of the field are limited. The task is, however, feasible if the development of soft skills can be addressed in a cumulative manner over the whole curriculum (as illustrated in Figure 8.2) and if the development of these skills is given equal weighting with technical content in the process of curriculum design.

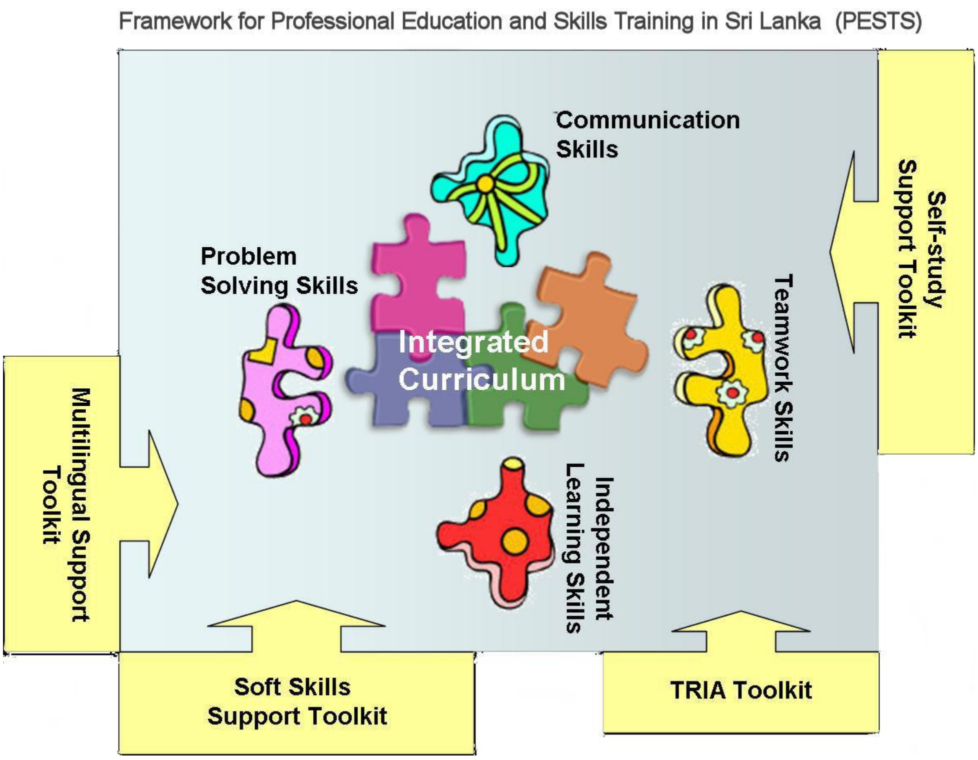


Figure 8.2: PESTS Framework showing the tools that scaffold the integrated curriculum

The subliminal message that isolating soft skill development in a single subject area or subjects presented by one individual sends to students should also not be overlooked. The point has already been made that the IT industry is one which is built on a foundation of teamwork and problem-solving such that the development and application of soft skills is appropriate across the curriculum and integrating it in this manner reinforces the message to students that mastery of these soft skills is

[108] Semester units were originally 13 weeks long but were made 16 weeks long in 2007 to compensate for frequently occurring strikes, stoppages and holidays which made it difficult for lecturers to cover their syllabi.

fundamental to success in the industry. Consequently, the central tenet of the PESTS framework (Fig. 8.2) is the need for an integrated curriculum supportive of the progressive development of soft skills over the course of study.

The tools developed in this study are shown in Figure 8.2 as a Multilingual Support Toolkit, a Soft Skills Support Toolkit, a Team Responsibility Individual Accountability (TRIA) Toolkit and a Self-Study Support Toolkit all scaffolding the learning experience. Table 8.1 summarizes information about the tools in these toolkits:

Table 8.1: PESTS Framework support toolkits – components and features

Multilingual Support Toolkit	Glossary	Glossary of terms – both technical and infrequently encountered plain English terms. Words in glossary in Moodle CMS link automatically to study texts or, alternatively, can be accessed through a dictionary-like interface.
	Mentors	Industry representatives who through their personal relationship with students model the language of the profession. Relationships are maintained largely through electronic media.
	Facilitator-led groups	In these sessions, groups are conducted in English so that all participants practice discussing concepts in informal English while the Facilitator models the formal language of the profession.
	Code switching	Small groups sharing a single mother tongue allow lecturers/facilitators to practice code-switching to ensure clarity of understanding.
	Audio lectures	Lecture notes recorded as PowerPoint presentations with audio overlay using a tool such as Articulate Presenter™ support verbal learners and allow students to familiarise themselves with the formal language of the profession at their own pace.
	Video	Video-taped interviews with industry representatives on technical topics covered in the course provide students with exposure to technical language as well as providing insights into current industry practice. Technical terms which students might not be familiar with are highlighted as text overlays and defined in the Glossary.
	Cloze passages, drag-and-drop exercises	Question types used in online learning materials to help students build language skills (uses Quiz and Drag-n-Drop modules in Moodle CMS).
Soft Skills Support Toolkit	Team building games	Used to build team cohesion at the beginning of the semester. We successfully used the Tinkertoy Game described by Wells (cited in Cohen 2002), team scavenger hunts and a variety of exercises from Thiagarajan & Parker (1999).
	Small group exercises	Exercises which require students to read and discuss or read and report back on topics ranging from effective meeting techniques to assessing one's own preferred learning style. Discussion within the group would ideally be in *swabasha* while reporting back would be in English.
	Videos	Video-taped interviews with industry leaders on the nature of the skills set they are looking for in new employees.
	Mentors	Informal relationship with industry representatives provides students with a source of first-hand information on types of soft skills highly regarded in industry.
	Industry-led seminar	Allows students to meet industry representatives and be briefed about work environments.
	Role Plays	Role play exercises particularly useful for prompting discussion about issues such as team discord and team participation.
TRIA* Toolkit	Wiki	Wiki module in Moodle CMS allows students from the same group to contribute to a common online editing area. Administrators have

*Team Responsibility Individual Accountability		access to all group wiki sites. Individual contributions can be traced by login name providing some indication of levels of participation.
	Viva Voce	Personal oral examination on topic of team assignment.
	Team Presentation	Requiring the whole team to report back on completion of team exercises/assignments, provides some measure of team participation particularly if combined with question-and-answer sessions at the end of the presentation or individual vivas.
	Closed Discussion Lists	Structuring a learning situation where teams have to question a "client" or interview an industry representative on a closed discussion list provides a permanent record for the lecturer of individual contributions to the discussion.
Self-Study Support Toolkit	Lessons	A 'lesson' is a Moodle module which allows learning material to be presented in variable length 'pages' separated by quiz questions. The student has to correctly answer a question to proceed to the next page.
	Quizzes	Moodle provides self-grading multiple choice and short answer quizzes.
	Videos	With the assistance of local industry representatives we were able to make a series of videos which illustrated local best practice in software engineering.
	Kuppi	A commonly used student forum where a more able student (sometimes a senior) conducts a tutorial in mother tongue for a group of his/her peers.
	Learning style inventories	Assists student to learn how best to harness their natural learning styles.
	Online lecture notes	Providing PowerPoint presentations online or Flash animations of same synched with a voiceover of the lecture (created here with Articulate Presenter™).

These tools were used in various combinations and at different times in a single subject area (IT2104: Software Engineering) to help students develop language and soft skills but could equally well be used across the curriculum. In the next section, the FIT syllabus is used to illustrate how a closely integrated curriculum could support the progressive development of graduate soft skills over the FIT degree program.

8.3.1 Application of the Framework to FIT

Recognising the importance of developing graduate soft skills such as problem-solving, teamwork and independent learning skills, FIT has already put in place a framework through which such skills can logically be developed. This primarily comprises the first, second and third year projects (IT1201: Digital Circuits and Devices, IT2999: ICT Design Project and IT3999: Project, respectively) with some additional inputs made during the Orientation Program for new students as already discussed in Chapter 1. The compulsory project units require students to work independently to research and resolve real-world problems. Such an approach would be similar to that adopted by Brodie and Porter (2001) who aimed to cumulatively develop required knowledge, skills and attributes in their engineering students over a series of four PBL courses at each year level of the degree program.

In FIT, all academic staff members are expected to supervise one or more project teams from each year providing an ideal opportunity for cross-curriculum links in a PBL environment. The second year project, for instance, requires students to locate a local business for whom they will design and develop a software system. This has the potential to integrate concepts learnt in IT 2104: Software Engineering, IT2802: Data

Management Systems and IT1102: Web Technologies.[109] Although it is not currently the practice, there would appear to be an advantage to be gained in assigning lecturers in these three subjects collective responsibility for the second year projects enabling them to draw on concrete and practical examples from the experience of project teams in teaching their own subjects and ensuring that students draw on cross-curricular knowledge in designing and building their project systems. At the same time, especially with the second and third year projects being full year subjects, there is ample opportunity to work on progressively developing teamwork, problem-solving and independent learning skills.

The development of communication skills and English language fluency would arguably be best done across all subjects since, in a professional development course, the development of the language of discourse is just as important as the development of general English skills. The approach used in the current study would stand as a good model of this.

It is readily apparent that this model falls short of the PESTS framework in the degree of curriculum integration recommended. This is intentional in that the model as recommended below is the blueprint for expanding the scope of the current study as a further and more extensive trial of the concept. If successful, such a trial would pave the way for wider integration of PBL into the curriculum. Based on concerns expressed by Faculty in the interviews reported in this study, I feel that a hybrid model of this nature is more likely to be acceptable to them and in Section 8.4 below I undertake an assessment of the readiness of the current learning environment in support of this. The adoption of a fully PBL curriculum should be the ultimate goal.

Figure 8.3 illustrates the concept of this progressive development of skills using the orientation program and the first, second and third year projects as the backbone of the curriculum framework, whilst communication and language skills are developed across the entire degree program. The tools developed in this study and summarized above (Table 8.2) are shown scaffolding the learning experience. In the second year, subject areas closely related to the topic of the second year project are shown feeding in professional skills and knowledge. While the same links do not currently exist in the first year, it is envisaged that a refocusing of the project could easily accommodate the same sorts of synergies. Since the third year project is virtually an industry placement, it could be expected to draw upon subjects from all years.

It is anticipated that the emphasis on different skills will vary from year to year (Fig. 8.3) although the relative emphasis shown is intended to be illustrative rather than definitive. Having said this, it is important to establish sound teamwork practices from the earliest stages as student experience of teamwork prior to entering the university is minimal. Comparing and contrasting the teamwork experiences of students in 2005 and 2007, a viable model would appear to be one which allows self-selection of team membership in early years moving progressively towards a situation that more closely approximates that in the workplace in the second and third years with appropriate scaffolding through the sorts of team building exercises already described (Fig. 7.18).

[109] Most projects for small businesses involve designing a system (Software Engineering) which is often based on a database (Data Management Systems) that is sometimes web enabled (Web Technologies).

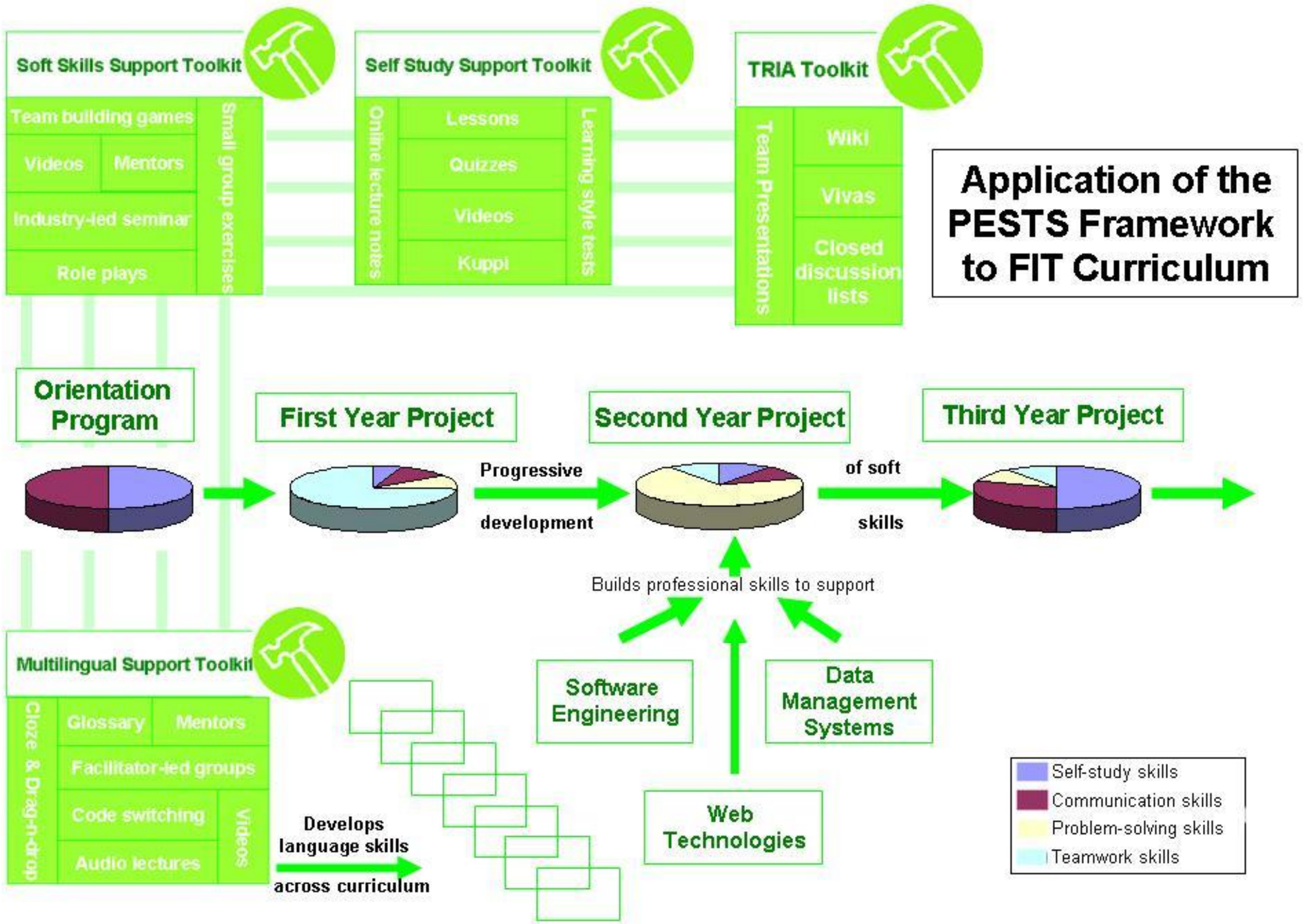


Figure 8.3: Proposed application of PESTS Framework to the FIT Curriculum

The actual relative emphasis placed on the different soft skills within each subject area should be determined collectively by the faculty spearheaded by the supervisors of the three project subjects. Clearly there needs to be a strong commitment by these supervisors and amongst senior staff as to the importance of developing soft skills. The point has already been made in Chapter 2 that it is important not to assume that something which might have been trialled successfully on a small scale and with the input of enthusiastic individuals can readily be scaled up in the manner proposed above. Questions need to be asked to ascertain whether the learning environment can support the proposed larger scale implementation.

> As we work to build upon the lessons learned from classroom-oriented design-based research, we need to define questions that explicitly address issues of scalability and sustainability, if we hope for innovations to enter into widespread use beyond their original research contexts (Fishman et al. 2004, p.48).

As the research domain in this instance was confined to a single course within a single faculty, the scalability and sustainability of the findings also need to be examined before any derived model can realistically be offered up for wider consumption.

It is worthwhile at this point to consider the experience of the University of South Australia which, similarly to most universities in Australia, adopted a policy, 'to embed employability skills into each level of the undergraduate curriculum to ensure that every student is fully equipped, at graduation, with the skills necessary for the very important transition into the world of employment' (Monday & Barker 2003, p.287). To this end, all academics at the university are required to submit a plan for the 'development of Graduate Qualities (GQs) throughout the duration of the program' and to 'match appropriate assessment methods to the graduate qualities' (Monday & Barker 2003, p.287). This has been a major undertaking and not always a smooth process. The next section questions whether a similar exercise, or something approaching it, would in fact be feasible within the current context, or beyond that, in professional tertiary education generally in Sri Lanka.

8.4 Feasibility of Scaling-up the Model

> Comparing with other subjects this is totally interested and we learned something. Thank you for doing this differently.
>
> (Respondent, Course Experience Questionnaire 2007)

This comment from one of the final group of students is, in one sense, encouraging and, in another, discouraging. It is, of course, encouraging in that students appreciated the efforts of the research team. However, it is discouraging in that even the small differences which we were able to make in their learning environment should be so appreciated by students when the unrealised potential for change is so great. The ideal for a PBL environment is one which does not simply bring problem solving into a traditional curriculum based on disciplines as in the current study. It builds a curriculum around key problems in professional practice.

> Problem-based courses start with problems rather than with the exposition of disciplinary knowledge. They move students towards the acquisition of knowledge and skills through a staged sequence of problems presented in context, together with associated learning materials and support from teachers (Bourd & Feletti cited in Jarvis et al. 2003, p.135).

Compared to this ideal, the changes proposed in the PESTS framework (Fig. 8.2) are relatively modest particularly as they are conceived to apply to FIT (Fig. 8.3). Nonetheless, questions about whether public endorsement by FIT of the importance of soft skills is felt sufficiently strongly to support even these modest changes since interviews with senior academic staff reported in earlier chapters have identified concerns about sacrificing coverage of technical content to spend time on skills development. Moreover, in assessing the scalability of a model of institutional change, it is also necessary to look beyond the opinions of individuals to systemic indicators. According to Fishman et al. (2004, p.48-9):

> A fundamental challenge of work in systemic reform contexts is creating alignment across the components of school systems, such as administration and management, curriculum and instruction, assessment, policy, and technology (Smith & O'Day, 1991). If the challenge of alignment can be met, an innovation has a better chance of being both sustained and scaled because the alignment of the system creates a stable structure and provides needed support.

Therefore, to assess the scalability of the PESTS framework, we need to question the degree of alignment in the university environment. To what extent are policy and practice within the university aligned with the sort of learning environment proposed? What changes might be required in management, curriculum, assessment, policies and technology to support the changes and to what extent do constraints in these areas pose as risk factors?

8.4.1 Administrative and Management Support

The involvement of all academic staff in the supervision of projects mentioned earlier in this chapter is intended to help students to apply skills and knowledge from a range of curriculum areas into a practical problem-solving exercise. However, the evidence suggests that the reality might not quite meet expectations.

> Even in the internal report we got on our project, there were no instructions as to how to develop our methods. They just correct spelling mistakes. Like highlighting where the capitals or simple letters must come. We didn't expect that. We expected like what are the errors or problems that would arise if we implement this… how to solve them. Like that.
>
> (Participant, Focus Group 2007)

From this comment it is apparent that students expected to be mentored and guided. This is consistent with a cognitive apprenticeship approach to learning which suggests that 'students need opportunities to see how experts analyse problems, to get feedback on their own actions, and to get suggestions during the process' (Wilkerson & Gijselaers 1996, p.16) and fits with the faculty mission of providing professional preparation. It is equally apparent from student comments that they were disappointed in the failure of academic staff to provide this mentoring and guidance. Failure to realise the potential of the projects as learning experiences is a lost opportunity for FIT.

The failure of academic staff to adopt a mentoring role in supervising project teams possibly points to a lack of ownership of the project subject. A staff member who might be active in supporting students in their own technical area may not feel the same accountability where there is a shared responsibility for a subject. From the personal experience of the researcher as the co-supervisor of the second year project subject, IT2999: ICT Design Project in 2006, it was difficult to organise meetings with all involved staff to be able to discuss issues where a consensus of approach was required. This does not augur well for being able to coordinate a common staff approach to an integrated program of PBL targeting development of key soft skills. Such an approach requires commitment from all staff.

Khoo (2003) reviewing the implementation of PBL in medical schools in Asia, also found that strong support by staff is a key success factor.

> Gwee and Tan described their experience with implementation of a hybrid curriculum, with 20% of curriculum time devoted to PBL at the National University of Singapore Medical School. They concluded that appropriate training and changing the mindset of staff and students, strong leadership from the dean and a deep commitment by all concerned are essential to ensure the successful implementation of PBL within a traditional school (Khoo 2003, p.404).

It is clear that students feel the current hands-off approach to project supervision to be inadequate and it is, moreover, inconsistent with the degree of support and scaffolding recommended in the optimal learning environment described in Figure 8.1, nor the ‘deep commitment’ described as so important in similar regional contexts by Khoo (2003). The projects that students take on at every year level are real world and complex in nature and require the application of solid problem-solving skills for their resolution. The learning environment is also ideal for the planned and progressive development of teamwork and independent learning skills. However, based on the experience gained from this study, student teams will need a significant amount of scaffolding to get the most benefit out of the program – support even beyond mentoring and guidance. Ideally, student teams will work closely with a trained facilitator.

8.4.1.1 Facilitation of team work

Facilitation of PBL groups is a difficult skill for lecturers trained in traditional teaching/learning environments to develop and the facilitators in the first year of this study benefited greatly from contact with trained implementers of PBL at Temasek Polytechnic.[110] The Medical Faculty at Colombo University, one of the few local institutions to have tried a PBL approach, echo the need for skilled, well trained facilitators (Khoo, 2003):

> [T]he investigators concluded that the mode of conducting PBL sessions needed to be improved; that more attention should be paid to problem design to make the problems presented more relevant and interesting; that the atmosphere of PBL sessions should be made less threatening and more comfortable, and that training of facilitators should be enhanced (Khoo 2003, p.406).

Training of facilitators might be easier to accommodate if a limited number of staff with relevant technical backgrounds were made responsible for each project as suggested above. Staff need to be reminded of the original raison d’etre for introducing the project subjects to the FIT syllabus i.e. the fact that application skills are fundamental to the Faculty mission and vision and are embodied in the project subjects. Awareness needs to be raised of the critical importance of soft skills that these projects were put in place to develop.

Cavanaugh (2001) also points to the need for procuring extramural funds to support the early stages of any reform agenda and ensuring that staff involved in the reform process are released from other commitments. The training of facilitators and ensuring their availability would be two primary resourcing requirements in any scaling up of this model. In the first year of the study, I was fortunate enough to be able to call upon some dedicated staff who gave freely of their extra time and was able to fund them to attend the PBL conference at Temasek Polytechnic. However,

[110] Two facilitators attended a conference organised by Temasek Polytechnic in 2005. The conference was notable for its hands-on workshops and the opportunity for participants to open up dialog with experienced PBL facilitators from the institution.

working with faculty instructors in the final year of the study was not as effective as these people did not have the appropriate background and were unable to spare the time during the semester for training and preparation. Releasing facilitators for training and then ensuring that the timetable supports their full commitment to the reform are essential.

8.4.1.2 ESL Support

The FIT model also assumes that attention will be paid to the development of English language skills in all subjects. Whilst the faculty has introduced a variety of initiatives to help students improve their English skills ranging from book clubs to informal libraries, the only formal support for student language development is in the Orientation program and in the first year subject, IT1002: Communication Skill Development. There is a general expectation that student language skills will improve simply by being exposed to an English language learning environment. When administrative problems within the Ministry of Education caused a delay in the intake of students in 2006, the three month orientation program, which includes an English language bridging course, was cut to two weeks rather than reduce time available to other subjects. This may reflect an attitude that formal language training is less important than technical training.

To be able to introduce English language support methods and approaches across the curriculum, there would firstly have to be an acknowledgement by faculty management that the current support mechanisms are insufficient and, secondly, that language skills are best developed in the domain within which they will be used rather than in isolated courses. This would have to be reinforced by a commitment to ongoing curriculum reform in the area.

FIT lecturers clearly recognise the problem caused by limited English language fluency but the solutions proffered in interviews concentrated on using specialist courses and/or letting students learn from experience.

> Students come to the university expecting to learn English on campus and most times they are successful. In my subject, I always get them to do presentations and others also do. By the end of the third year, most of them have good communication skills.
>
> (Lecturer, Academic Staff Interview 2005)

Despite the fact that university campuses in Sri Lanka have been multilingual learning environments for some time, little has been done in the way of ESL support beyond the establishment of English Language Training Units (ELTU) in each faculty. It may be timely for the ELTU, as the agency within the university context with the most exposure to the latest knowledge about multilingual learning environments, to foster professional discussion to enhance awareness of alternatives. It would appear that some faculty members already practice the fundamentals of Sheltered Content Instruction referred to in Chapter 6 and may be receptive to professional training and support in the area.

> The solution is with us. We have to make them feel free to talk to us but we have to make them good listeners first. We have to express ourselves in simple English and encourage them to answer back in simple English. We need to have certain classes like communication development classes where they are forced to speak in English with some sort of penalty if they don't speak in English.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Moreover, the university is fortunate in that students are enthusiastic about learning English. This is not the case for all universities in Sri Lanka. For instance, Jansz (n.d.) reports hostility among Arts students in the University of Colombo towards learning English (described more fully in Chapter 3).

However, given the anticipated costs of staff training and awareness raising to provide support for a wide scale implementation of the PESTS framework, the area of management and administration would have to be seen as an area of moderate risk.

8.4.2 Curriculum and Instruction Support

Rolling out the PESTS framework across the curriculum will require some consensus – ideally between all academic staff – about how the targeted skills will be progressively developed across the three years of the degree program, the appropriate role for industry mentors, and how to assess soft skill development. This consensus will need to be translated into a syllabus and work program including small group exercises, team building activities, industry-led seminars and role plays. Support materials will need to be developed and, as mentioned above, staff will need to be trained in facilitation skills.

This level of support might be difficult to garner where staff feel that their primary role is the transmission of technical knowledge, with development of soft skills best relegated to management subjects or even made the responsibility of industry.

> But now we are having assignments as well [as examinations], we can include the skills side of things especially in the management type of subjects but in the technical subjects even the assignments should be made use of to get improving the technical side. We should not try to put too much of other capabilities on that side like you were talking about the PBL. But if there is a technical subject, we should not try to force the lecturer to do group activities, they should be left to do assignments plus the examination – assignments to make sure that the continuous application is there but we should not try to force them to use group activities.
>
> I think we have to do more about awareness [of the importance of soft skills] for which industry help would be mostly required. So we have to change the attitudes of the industry as well to some extent because what they are saying is that if somebody is having the proper attitude or the proper skill, I will pay him a little bit more and take him. Rather than thinking about the people who are not having it. They in turn will try to say that the university has not done it. Not changed the skills of the students adequately for us to take them in. The amount of responsibility that is being taken by the industry in skill development – if it was a knowledge problem, then I think there is no excuse for the university – but even the industry or the country as a whole will have to accept that, within 3 years, you can't change a person very much. That does not mean we are trying to avoid our responsibilities. But there again, what I am trying to say, is that we will have to make them also aware that it is their responsibility, it is good for them, good for the industry, good for us…which I personally do not think they have realized. They are always saying, "We are the taxpayers. We want you to do it"
>
> (Senior Lecturer, Academic Staff Interview 2005)

However, a start has already been made in this direction by including an orientation to problem-solving in the three month Orientation Program for first year students. This demonstrates to students that problem-solving skills are a fundamental component of the course they are about to embark on.

The fact that all FIT students are undertaking their course on a full-time, face-to-face basis will make it easier to introduce an integrated curriculum. Savin-Baden (2000) identified the shift to mass higher education in both the UK and Australian contexts as a possible threat to pedagogies that promote learning with and through others, such as PBL, and which promote integration of learning across disciplines, since increasing numbers of students undertake higher education on a part-time basis.

In terms of language development, a program of training should be conducted for lecturers in supporting learners in a multilingual environment. One output of such a program should be a range of support materials including subject-specific glossaries. Although there are likely to be certain economies of scale if a cross-curricular glossary is built to be shared under Moodle, building the subject specific parts of this glossary is still a significant undertaking and best done in the context of a formal program. This is particularly the case if definitions are to be supplemented with Sinhala and Tamil explanations as suggested by focus group participants in this study.

The School of Electrical Engineering at Victoria University (VU) in Australia has recently introduced just such a training program in support of their PBL program. In 2006, the university adopted a PBL approach in response to professional bodies such as the Engineers Australia Accreditation Board, requiring students to graduate with good interpersonal and communication skills. A major problem faced by the university was that, coming from '...a wide range of socio-cultural, linguistic and ethnic backgrounds ... Many students commencing VU engineering courses face[d] language difficulties: poor command of English, sometimes with an extremely poor ability in written English ...' (Mphande et al. 2007, p.44-5). Accordingly, the university sought help to conduct a series of training workshops for staff designed to '... acquaint the electrical engineering staff with pertinent language learning theory and metalanguage; learning strategies and major learning style preferences so that they would be able to analyse and evaluate student reports and reflective writings' (Mphande et al. 2007, p.45-6).

A staff development exercise on a similar scale has recently been undertaken by FIT in the context of developing a distance education qualification. Under the assistance and guidance of the ADB[111] funded Distance Education Modernization Project, many of the faculty were trained in how to develop modules for distance learning. Staff developing modules for the program were subsequently paid for work done.

However, many academic staff have had no pre-service teaching training and in-service training is generally limited to technical training to enable staff to stay abreast of recent IT industry developments. While limited in-service teacher training is available through the university Staff Development Centre (Chapter 3), a more comprehensive training program targeting teaching methods would be required and may need to be strongly endorsed by senior management and promoted through seminars and workshops. Overall, the area of curriculum and instruction support, would probably rate as an area of moderate risk.

8.4.3 Assessment Support Base

In implementing it's cross-curriculum soft skills development program, the University of South Australia notes that it is imperative to 'match appropriate assessment methods to the graduate qualities' (Monday & Barker 2003, p.287). This will also be important in the current context as students in this study have shown themselves to be quick to perceive discrepancies between faculty rhetoric and the "real message" as conveyed by the exam paper.

> They tell us not to memorize or study too hard, but they expect it.
>
> (Participant, Focus Group 2007)

[111] Asian Development Bank – a multilateral aid organization.

Lecturers are equally well aware of this.

> Like in all faculties everywhere, if they know that they are going to be assessed, they will learn it. That is the theory. And, if they know that, even if they fool the system in these assessment, they will be assessed later where they will have to pay in rupees or position, there also they will do it. So what I was trying to say was that we will have to develop our assessment systems in these skills as well – more than that to make students aware that you are going to be assessed by your company, as well as your peers, as well as your customers one day, then I think 90% of the job will be done.
>
> (Senior Lecturer, Academic Staff Interview 2005)

Shanker (2006) reporting on initiatives in PBL in medical education in South Asia (primarily Nepal), describes a mismatch of messages that may be typical of the region. While the syllabus in medical schools is taught through problems, the examinations continue to test factual recall. 'In the practical examination, the students have often been shown the problems/charts. Teachers do not want their students to be confronted with an unknown question, problem or chart in the examination. [Hence] the "problem solving exercises" become a matter of testing recall' (Shanker 2006, p.12).

Students will judge the value that the faculty places on soft skill development through how it is assessed and the weighting given to its assessment. Koppenhaver and Shrader (2003, p.10) report that they encouraged team members to support each other by introducing a system of team points which could be earned 'when all team members, for example, earn more than a predetermined percentage on the same exam, successfully complete a team problem-solving assignment given in class, lead or critique a case discussion, or make a presentation to the class'. Similar approaches could possibly be employed in the current context. Whatever the method used, a misalignment of subliminal and overt messages similar to that currently reported in focus groups could place the proposed program in jeopardy. Hence this area should be seen as one of significant risk.

8.4.4 Policy Support Base

The faculty has considerable autonomy within the university and the university system itself has a great deal of independence from the education department and political influence being answerable only to its Council and Senate which are, by and large, internal bodies.[112] Although there is no student representation on these bodies, most of the universities have experienced extended closures over the years due to student unrest and so are, in a sense, answerable to the student body. However, this is unlikely to be relevant to the proposed reforms since, to a large extent, they address student concerns.

Some of the policy constraints which impacted on this study such as the 80% lecture attendance regulation and timetabling inflexibility are irrelevant in the context of the project subjects where there is considerably more flexibility.

Overall, university policy is unlikely to constrain implementation of the framework should the initiative receive faculty support.

---

[112] The Council is the executive and the governing authority of the University and is chaired by the Vice-Chancellor. Membership includes Faculty Deans and some distinguished citizens. The Senate is the academic authority of the University and is chaired by the Vice-Chancellor. Membership is taken entirely from within the university including Deans, Professors and lecturer representatives.

8.4.5 Technology Support Base

Throughout this study, students claimed that they simply did not get enough time in computing labs. This impacted on the trialing of support tools with Moodle site statistics (see Chapter 6) showing rapidly diminishing usage of lessons, quizzes and online lecture notes when tutorial time was not specifically made available for students to use these tools. To some extent this can be attributed to poor time management skills on the part of the students themselves who admitted leaving self-study until a short time before the exams. However, the volume of complaints in this area cannot be ignored and the inadequacy of the technology support base must be viewed as a key risk in any large scale rollout of the framework.

> The other problem is that all of us have lectures at the same time and lab sessions also at the same time. We don't have access to the lab after those times…..During the lecture times, the labs are completely free. Only lab assistants are there. Therefore the co-ordination and strategies can be used to minimize these. We are not asking for a PC per student. They can give one batch the lab session when others are having lecturers. The scheduling needs to be looked into.
>
> (Participants, Focus Group 2007)

> There is a quiz after the description of every lesson. After clicking it we can go to the next topic. But we did it only on the first two weeks. We can learn more from this quiz but we don't have enough time to follow it. We can't use our computer labs for self studies on weekdays. After the lesson some lecturers ask us to complete this quiz but there is no space at the computer labs.
>
> (Participant, Focus Group 2007)

> There is no UPS [uninterruptible power supply] for our university computers. Sometimes computers restart unexpectedly. If we don't save our things we have to type it again. Actually it is a big problem. It wastes our time. When we did our "wiki" project we faced such a problem.
>
> (Participant, Focus Group 2007)

In response to this issue, a CD was produced containing all of the eLearning tools made available on the Moodle site so that students could access the materials at home or in their boarding place. However, as a compensatory measure, this presupposes that all students have access to computers outside the university. It also assumes that students will have sufficiently well developed time management skills to allocate time to self-study even some months before the exams. The evidence suggests that neither of these may be entirely valid assumption but the extent to which the latter is due to factors such as assignment overload and compulsory lecture attendance standing in the way of students taking control of their own learning, is difficult to say. It does, however, reinforce the importance of developing soft skills such as time management and independent learning skills and of developing the sort of integrated learning environment within which such skills can be gradually developed over the course of study and in a variety of contexts.

8.5 Recommendations for future study

Although practitioners of design-based research generally acknowledge that there are no set rules for studies in the genre, Gorard (2004) put forward the generic model for a design-based research study illustrated in Figure 8.4.

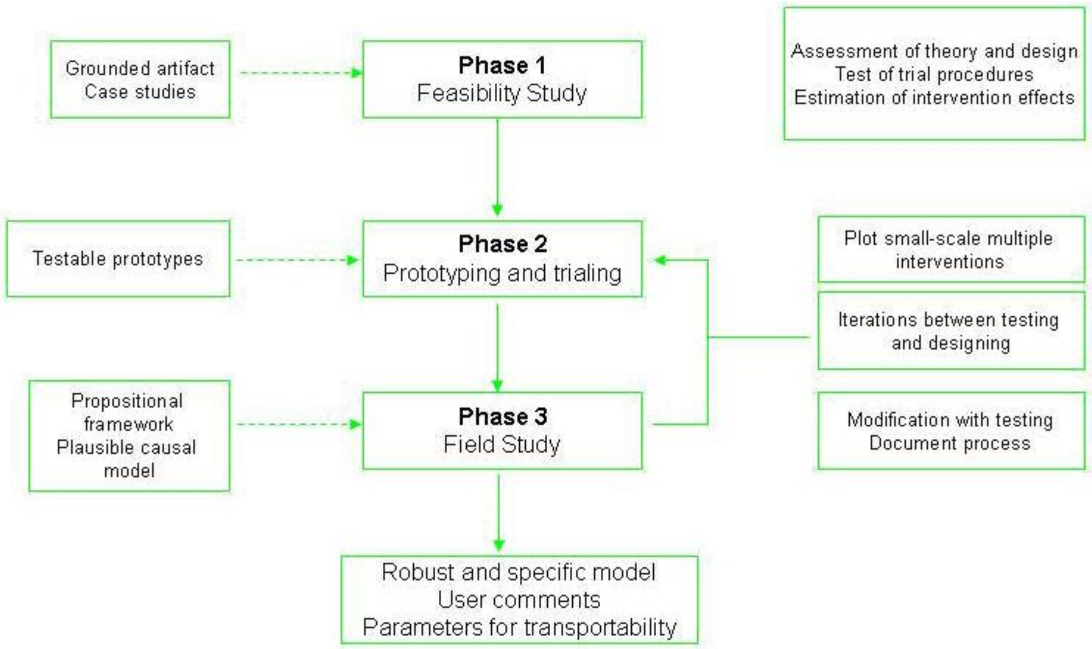


Figure 8.4: General procedure for design experiments taken from Gorard (2004, p.109)

This model suggests that there should be 3 phases in a design-based research program with iteration between phases 2 and 3. The phases are :

1. Feasibility Study
2. Prototyping and trialing
3. Field Study

The Feasibility Study phase approximates the initial years of this study starting with '... an initial design of the intervention, ensuring that the intervention was grounded in whatever theory was available and an explicit interpretation of the proposed causal mechanism' (Gorard 2004, p.109). Gorard suggests that:

> The early stages of the feasibility study … involve primarily qualitative methods in the formative evaluation of the intervention, using interviews, focus groups, observation and case studies to identify how the trial intervention is working, barriers and facilitators to its implementation, and provide early indications as to how it may be improved (Gorard 2004, p.110).

In this study, the initial intervention was designed after considering the results of focus group discussions with existing Software Engineering students, interviews with lecturers, and a desk study of research relevant to the domain and the local context (the baseline study).

The Prototyping and Trialing phase:

> [B]egins a process of iteration between the testing and further modification of the intervention. Parallel to this is the potential to iterate the process between the laboratory (or other controlled environments) and the classroom (or real life environments). These iterative processes continue into the third phase (field study). .. As the iterations between testing and further design become more sophisticated, and the iterations between laboratory and classroom settings become more robust, advances are made in the intervention's propositional framework and in outlining its plausible causal models (Gorard 2004, p.110).

The current study can be said to have gone through this prototyping and trialing phase in the final three years (2005-2007) with the result that it is possible to identify the aspects of the design which can be deemed successful and to generate a propositional framework. The findings of this prototyping and trialing phase have been presented in Chapters 4 – 7.

However, the intervention has not been field tested. Gorard (2004) suggests that the 'field study should involve a definitive test. In the design experiment, this definitive trial could take the form of a randomized controlled trial, an interrupted time series analysis (Harris & Corcoran 2002) or a concurrent quasi-experiment (McGee et al. 2002)' (Gorard 2004, p.110). Khoo (2003) reports an appropriate field test done in a similar context – a medical college in India starting out with a PBL approach. Given the similarity of context, this might be an appropriate model.

> Chandra et al. (1996) studied the impact of PBL in a pharmacotherapeutic course on the cognitive and motivational attitudes of second year medical students in Maulana Azad Medical College in New Delhi, India. They compared three groups of students, where two groups were exposed to PBL methods while a third served as a control. One PBL group was assigned a simple problem stated in written form. The other group was exposed to a programmed patient. Both groups were divided into small groups of six students and then briefed in a first session by a tutor. They then had to carry out self-learning before the second session, at which a discussion was then facilitated by the same tutor. The control group attended routine didactic lectures without any group discussion. The cognitive tests using multiple-choice questions showed no difference between all three groups. However, motivational changes were noted as the PBL groups reported that they appreciated the exercise and suggested including more such exercises in the curriculum. They reported that these PBL exercises had helped them to better understand patient problems and improve their own prescribing behaviour as well as develop communication skills. However, the exercises were time-consuming. These responses appear rather similar to those from other countries (Khoo 2003, p.405).

Although the potential value of a field test is acknowledged, it was not possible to conduct such a "definitive trial" in this study given that there was only one class of Software Engineering students and it was neither logistically possible nor acceptable to the university administration to split the group.

Gorard (2004) himself acknowledges that field testing a design is an ideal more often than a practice.

> A weakness of design experiments is that in practice there may be no definitive test or evaluation conducted on the artefact, intervention or initiative at any time. This is inevitable given the main objective of generating a design infrastructure rather than a final product. However, it should be necessary, particularly when taking an artefact, intervention or initiative into the marketplace or to policy-makers, to undertake a full trail so as to measure its performance and effectiveness (Gorard 2004, p.111).

Accepting Gorard's assessment that the conclusions of the study would be strengthened if it were possible to draw on a field test, it is a recommendation of this study that the Faculty Board of FIT should consider a definitive trial of the framework initially following the hybrid model described earlier in this chapter (Fig. 8.3). The manner in which the trial should be structured so as to satisfy the requirement for an experimental or at least a quasi-experimental approach, are best negotiated at the time with faculty management.

In considering the various elements of the university teaching learning environment likely to impact on the success of such a trial, this chapter has identified a number of areas of moderate and significant risk which should be directly addressed by the Board prior to agreeing to the trial.

REFERENCES

Abdulrazzaq, YM & Qayed, KI 1991, 'A study of the attitudes of the foundation staff of a new medical faculty to problem-based learning', *Medical Teacher*, vol. 13, no. 4, pp. 273-9.

Abraham, T 1998, 'The Interactive, Virtual Management Information Systems (MIS) Classroom: Creating an Active Learning Environment on the Internet', *Proceedings of the 3rd WebNet 98 World Conference of the WWW, Internet and Intranet*, Orlando, Florida, 7p.

Asian Development Bank 2000a, 'Labour Force Experience of Persons with A Levels and Degrees and above in Sri Lanka 1993-1997', *Report of TA 3073: Improving Educational Planning*, ADB, Colombo, Sri Lanka.

Asian Development Bank 2000b, 'Advancing Knowledge and Skills for Development and Competitiveness: The Tertiary Education Strategy', ADB Development Forum, Paris.

Asian Development Bank 2003, *Expanding Sri Lanka's Postsecondary Education with Distance Learning*, media release, 13 June, ADB, Manila, Philippines, viewed 2nd August, 2003 at http://www.adb.org/printer-friendly.asp?fn=%2FDocuments%2FNews%2F2003%2Fnr2003084.asp.

Adler, J 2001, *Teaching Mathematics in Multilingual Classrooms*, Kluwer Academic Publishers, Norwell, Massachusetts, viewed 28th January, 2007 at http://site.ebrary.com.ezproxy.usq.edu.au/.

Aldred, SE, Aldred, MJ, Walsh, LJ, & Dick, B 1997, *The Direct and Indirect Costs of Implementing Problem-Based Learning into Traditional Professional Courses within Universities*, Evaluations and Investigations Program, Higher Education Division, Department of Employment, Education, Training and Youth Affairs, Canberra, Australia, viewed 21st May, 2006 at http://www.dest.gov.au/archive/highered/eippubs/eip9709/front.htm

Allen, DE, Duch, BJ, & Groh, SE 1989, 'The Power of Problem-Based Learning in Teaching Introductory Science Courses', in L Wilkerson and WH Gijselaers (eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice*, Jossey-Bass Publishers, San Francisco, California.

Baker, C (ed.) 2001, *Bilingual Education and Bilingualism, 27 : Foundations of Bilingual Education and Bilingualism*, Multilingual Matters Limited, Clevedon, Great Britain

Bandarage, A 1998, 'College Degrees Bear Bitter Fruit in Sri Lanka', *The Chronicle of Higher Education*, vol. 45, no. 17

Banta, TW, Black, KE, & Kline, KA 2000, 'PBL 2000 Plenary Address offers evidence for and against Problem-Based Learning', *PBL Insight*, vol. 3, no. 3, pp. 1-7.

Barab, S & Squire, K 2004, 'Design-Based Research: Putting a Stake in the Ground', *The Journal of the Learning Sciences*, vol. 13, no. 1, pp. 1-14, viewed 15th June 2008, EBSCO Host Academic Search Premier, item: AN12055960

Barg, M, Fekete, A, Greening, T, Hollands, O, Kay, J, Kingston, JH, & Crawford, K 1999, 'Problem-Based Learning for Foundation Computer Science Courses', *Computer Science Education*, vol. 10, no. 2, viewed 2nd May 2004 at http://www.cs.usyd.edu.au/~judy/PBL/tr_cse_pbl99.pdf.

Bentley JF, Lowry GR, Sandy GA 1999, 'Towards The Compleat Information Systems Graduate: A Problem Based Learning Approach', *Proc.*

10th Australasian Conference on Information Systems, Victoria University of Wellington, 1-3 December, viewed 6th June 2004 at http://www.vuw.ac.nz/acis99/Papers/PaperBentley-167.pdf

Bichelmeyer, BA & Hsu, YC 1999, 'Individually-Guided Education and Problem-Based Learning: A Comparison of Pedagogical Approached from Different Epistemological Views', *Proceedings of Selected Research and Development Papers presented at the National Convention of the Association for Educational Communications and Technology*, AECT, Houston, Texas

Bonk, CJ & Cunningham, DJ 1998, 'Searching for Learner-Centered, Constructivist, and Sociocultural Components of Collaborative Educational Learning Tools' in CJ Bonk & KS King (eds.), *Electronic Collaborators: Learner-Centered Technologies for Literacy, Apprenticeship, and Discourse*, Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey.

Borgatti, S 2008, *Introduction to Grounded Theory*, article, Analytic Technologies, Lexington, Kentucky, viewed 2nd August, 2007 at http://www.analytictech.com/mb870/introtoGT.htm.

Briggs Myers, I 1998, *Introduction to Type : A Guide to Understanding Your Results on the Myers-Briggs Type Indicator*, CPP Inc., Mountain View, California

Brodie, LM 2007, 'Reflective writing by distance education students in an engineering problem based learning course', *Australasian Journal of Engineering Education*, vol. 13, no. 2, pp.31-39

Brodie, LM & Porter, MA 2001, 'Delivering Problem Based Learning Courses to Engineers in On-Campus and Distance Education Modes', *presented at the 3rd Asia Pacific Conference on PBL*, Rockhampton, Australia, 9-12 Dec.

Brown, AL 1992, 'Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings', *The Journal of the Learning Sciences*, vol. 2, no. 2, pp. 141-178, viewed 20th April 2008, EBSCO Host Academic Search Premier, item AN 7598687

Cammish, NK 1997, 'Through a glass darkly - Problems of studying at advanced level through the medium of English', in D McNamara & R Harris (eds.), *Overseas Students in Higher Education: Issues in Teaching and Learning*, Routledge, London.

Cavanaugh, JC 2001, 'Making It So: Administrative Support for Problem-Based Learning' in BJ Duch, SE Groh & DE Allen (eds.), *The Power of Problem-Based Learning : A Practical "How To" for Teaching Undergraduate Courses in any Discipline*, Stylus Publishing, Sterling, Virginia.

Chandrakumara, A & Sparrow, P 2004, 'Work Orientation as an element of National Culture and its impact on HRM Policy-Practice Design Choices', *International Journal of Manpower*, vol. 25, no. 6, pp.564-589, Emerald Insight Management Xtra 111, item 01437720.

Chandrasiri, S 2008, 'The Labour Market Experience of University Graduates in Sri Lanka', *Higher Education Policy*, vol. 21, no. 3, pp. 405-423, viewed 10th December 2008, ERIC, item EJ806290.

Coelho, E 2004, *Adding English - A Guide to Teaching in Multilingual Classrooms*, Pippin Publishing Corporation, Toronto, viewed 24th July, 2006 at http://site.ebrary.com.ezproxy.usq.edu.au.

Cohen, E 2002, *Challenges of Information Technology Education in the 21st Century*, Idea Group Publishing, Hershey, Pennsylvania, viewed 5th May 2006 at http://site.ebrary.com.ezproxy.usq.edu.au.

Collins, AD, Joseph, D, & Bielaczyc, K 2004, 'Design Research: Theoretical and Methodological Issues', *The Journal of the Learning Sciences*, vol. 13, no. 1, viewed 4th April 2008, Academic Search Premier, item AN 12055989.

Conway, J & Little, P 2000, 'From Practice To Theory: Reconceptualising Curriculum Development for Problem-Based Learning' in OS Tan, P Little, SY Hee & J Conway (eds.), *Problem-Based Learning: Educational Innovation Across Disciplines*, Temasek Centre for Problem-Based Learning, Singapore.

Computer Society of Sri Lanka 2001, 'Information and Communications Technology Manpower and Skills Survey Sri Lanka 2000/2001- Regional ICT Manpower Survey', SEARCC, Colombo, Sri Lanka

Design Based Research Collective 2003, 'Design-Based Research: An Emerging Paradigm for Educational Inquiry', *Educational Researcher*, vol. 32, no. 1, viewed 21st July 2006 at http://www.tophe.net/papers/dbrc03.pdf.

de Mel, T 2007, 'Only tinkering, no reform of education - The Lalith Athulathmudali Memorial Oration', *The Sunday Times*, 9th December, viewed 14th April, 2008, sundaytimes.lk/071209/Plus/plus00010.html

Denscombe, M 2003, *Good Research Guide : For Small-Scale Research Projects (2nd Edition)*, McGraw-Hill Education, Berkshire, GBR, viewed 14th April 2006 at http://site.ebrary.com.ezproxy.usq.edu.au.

Dick, B 2002a, *Action research: action and research*, article, viewed 6th March 2006 at http://www.uq.net.au/action_research/arp/aandr.html.

Dick, B 2002b, *Grounded theory: a thumbnail sketch - Resource papers in action research*, article, viewed 6th March 2006 at http://www.scu.edu.au/schools/gcm/ar/arp/grounded.html#a_gt_intro.

Dimmock, C 2000, *Designing and Leading the Future School: A Cross-Cultural Perspective*, Falmer Press Limited, London, viewed 16th March, 2005 at http://site.ebrary.com.ezproxy.usq.edu.au.

Dirckinck-Holmfeld, L 2009, Innovation of Problem Based Learning through ICT: Linking Local and Global Experiences, *International Journal of Education and Development using ICT*, vol. 5, no. 1, viewed 3rd September, 2009 at http://ijedict.dec.uwi.edu/viewarticle.php?id=682&layout=html

Dixon, A 2000, 'Problem-Based Learning: Old Wine in New Bottles', *presented at the 2nd Asia-Pacific Conference on Problem-Based Learning*, Temasek Centre for Problem-Based Learning, Singapore, 5-7 Dec.

Dodge, B 1997, *Some Thoughts about WebQuests*, San Diego State University, San Diego, viewed 1st April 2005 at http://webquest.sdsu.edu/about_webquests.html

Dore, R 1976, *The Diploma Disease*, Allen & Unwin, London

Duch, BJ 2001, 'Models for Problem-Based Instruction in Undergraduate Courses' in BJ Duch, SE Groh & DE Allen (eds.), *The Power of Problem-Based Learning : A Practical "How To" for Teaching Undergraduate Courses in any Discipline*, Stylus Publishing, Sterling, Virginia.

Farrell, GM 1999, *The Development of Virtual Education: A Global Perspective*, Commonwealth of Learning, Vancouver, Canada

Fekete, A, Kay, J, Kingston, J, Wimalaratne, K 2000, 'Supporting Reflection in Introductory Computer Science', *Proceedings of the thirty-first SIGCSE technical symposium on Computer Science Education*, ACM SIGCSE Bulletin, vol. 32, no. 1, p144-148

Fernando, JNO 2004, 'Distance Education at Tertiary Level: An Effective Non Conventional Solution to Overcome the Severe Competition for University Education in Sri Lanka', *presented at the Third Pan-Commonwealth Forum on Open Learning*, Dunedin, New Zealand, 4-8 July.

Fishman, B, Marx, RW, Blumenfeld, P, Krajcik, J, & Soloway, E 2004, 'Creating a Framework for Research on Systemic Technology Innovations', *The Journal of the Learning Sciences*, vol. 13, no. 1, viewed 14th February 2008, Academic Search Premier, item AN 12055994

Fong, AMK, O'Toole, JM, & Keppell, M 2007, 'The attitudes of teacher educators to the use of problem based learning: The video triggers approach', *Proceedings of ASCILITE 2007*, Singapore, 2-5 Dec

Freeman, MA 1997, 'Demographic Correlates of Individualism and Collectivism: A Study of Social Values in Sri Lanka', *Journal of Cross-Cultural Psychology*, vol. 28, no. 3, pp.321-341, viewed 8th July 2005 at http://jcc.sagepub.com.ezproxy.usq.edu.au/cgi/reprint/28/3/321

Gatfield, T 1999, 'Examining Student Satisfaction with Group Projects and Peer Assessment', *Assessment & Evaluation in Higher Education*, vol. 24, no. 4, viewed 3rd February 2007, Academic Search Premier, item AN 2984072

Glaser, BG 1965, 'The Constant Comparative Method of Qualitative Analysis', *Social Problems*, vol. 12, no. 4, pp.436-445, HeinOnLine Law Journals Library, University of California Press, viewed 12th February 2008 at www.heinonline.org.ezproxy.usq.edu.au

Gorard, S 2004, *Combining Methods in Educational Research*, McGraw-Hill Education, Berkshire, GBR, viewed 15th May 2008 at http://site.ebrary.com.ezproxy.usq.edu.au.

Goulding, C 2002, *Grounded Theory: A Practical Guide for Management, Business and Market Researchers*, Sage Publications Ltd., London

Gunawardena, C 1991, 'Linking Education with the World of Work in Sri Lanka: The Experience of Two Decades', *Educational Review*, vol. 43 no. 1, pp.79-89, viewed 17th February 2004 at http://web15.epnet.com/#AN9707150119-3

Gunawardena, CN 1998, 'Designing Collaborative Learning Environments Mediated by Computer Conferencing: Issues and Challenges in the Asian Socio-Cultural Context', *Indian Journal of Open Learning*, vol. 7, no. 1, pp. 101-119, viewed 9th September 2005, ERIC, item EJ566569

Hallinger, P, Slowinski, J, & Rodriguez, B 1999, *Managing Technological Change for Schools of the New Millennium - Instructor Edition*, Office of Educational Research and Improvement - Problem Based Learning Project, Washington, DC, viewed 21st May 2005, ERIC, item ED434419

Havard, B, Du, J, & Pate, G 2005, 'Peer Assessment in Group Projects: An Input Oriented Process', in C Crawford, DA Willis, R Carlsen (eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2005*, AACE, Phoenix, Arizona

Herrington, J, Oliver, R, Herrington, T, & Sparrow, H 2000, 'Towards a New Tradition of Online Instruction: Using Situated Learning Theory to Design Web-Based Units', *Proceedings of ASCILITE 2000 Conference*, viewed 7th January 2003 at http://www.ascilite.org.au/conferences/coffs00/papers/jan_herrington.pdf.

Hettige, ST 2000, 'Economic Liberalisation, Qualifications and Livelihoods in Sri Lanka', *Assessment in Education: Principles, Policy and Practice*, vol. 7, no.

3, pp. 325-333, viewed 25th March 2005, Academic Search Premier, item AN 3978149
Hettige, ST 2008, 'Higher Education, unemployment and youth unrest', *Daily Mirror*, 12th March, Colombo, Sri Lanka
Hettige, ST, Mayer, M, & Salih, M 2004, *School-to-work transition of youth in Sri Lanka*, ILO, Employment Strategy Department - Employment Policies Unit, Geneva, viewed 18th August 2006 at http://www.ilo.org/public/english/employment/strat/download/esp19.pdf
Hills, H 2003, *Individual Preferences in E-Learning*, Gower Publishing Limited, Aldershot, England, viewed 21st July, 2006 at http://site.ebrary.com.ezproxy.usq.edu.au.
Hilton, M 2002, *Enhancing Undergraduate Learning with Information Technology: A Workshop Summary*, National Academy of Sciences, Washington, DC, viewed 27th March 2005 at http://site.ebrary.com.ezproxy.usq.edu.au.
Hirsh, E, Hirsh, KW, & Hirsh, SK 2003, *Introduction to Type and Teams*, CPP, Inc., Mountain View, California
Hoadley, CM 2004, 'Methodological Alignment in Design-Based Research', *Educational Psychologist*, vol. 39, no. 4, pp.203-212, viewed 19th August 2008, Academic Search Premier, item AN 14963078
Holzer, SM & Andruet, RH 2005, *A Multimedia-Workshop Learning Environment for Statics*, web page, viewed 18th March 2005 at http://fie.engrng.pitt.edu/fie95/2b5/2b51/2b51.htm
Hummelbrunner, R 2000, 'A Systems Approach to Evaluation', *Proceedings of 4th EES Conference*, Lasuanne, Switzerland, 12-14 Oct.
Hung, W, Bailey, JH, & Jonassen, DH 2003, 'Exploring the Tensions of Problem-Based Learning: Insights from Research', in DS Knowlton & DC Sharp (eds.), *Problem-Based Learning in the Information Age*, Jossey-Bass, San Francisco, California.
ICEL 2006, *Curriculum Development Guidelines. New ICT Curricula for the 21st Century: Designing Tomorrow's Education*, International Co-operation Europe Ltd. (ICEL), viewed 5th April 2008, ERIC item ED459343
International Development Agency 2007, *Education for all in Sri Lanka*, media release, World Bank, Washington, viewed 14th July, 2008 at http://web.worldbank.org.
iGovernment Bureau 2007, 'Sri Lanka to launch $80 mn education programme', media release, *Blue State Media*, viewed 2nd February 2008 at http://www.igovernment.in/site/sri-lanka-to-launch-80-mn-education-programme/.
ITC-ILO, AFAEMME, & SIPTU 2006, *Bulletin No. 3: Women Job Mobility in the ICT Sector - Soft Skills*, European Commission, DG of Employment, Social Affairs and Equal Opportunities, viewed 5th February 2008 at http://ict.womenmobility.org/pdf/ICT_Bulletin3.pdf
Jansz, M n.d., 'It's a Matter of Degree: the Pros and Cons of the University System in Sri Lanka', web page, *Abooda*, viewed 3rd September 2008 at http://www.abooda.com/Feature/Education041102.asp.
Jarvis, P, Holford, J, Griffin, C, 2003, *The Theory and Practice of Learning, 2nd Edition*, Kogan Page Limited, London.
Jayawardana, AKL & O'Donnell, M, 2007, 'Problem-Based Learning for Postgraduate Students in Sri Lanka', *Journal of Management Education*, vol. 31, no. 5, pp. 679-695, viewed 4th April 2008, Sage Journals Online.

Jonassen, D 1998, 'Designing Constructivist Learning Environments', in CM Reiguluth (ed.), *Instructional Theories and Models*, 2nd Edition, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey.

Jonassen, D, Davidson, M, Collins, M, Campbell, J, & Bannan Haag, B 1995, 'Constructivism and computer-mediated communication in distance education', *The American Journal of Distance Education*, vol. 9, no. 2, pp. 7-26

Kabir, M, & Nelson, N 2000, 'Project-Based Applied Engineering Curriculum - A Practitioner's View', *Proceedings of Reinventing PBL - International Problem-Based Learning Symposium*, Republic Polytechnic, Singapore, 7-9 March, p.174-185

Kay, J, Barg, M, Fekete, A, Greening, T, Hollands, O, Kingston, JH, Crawford, K 2000, 'Problem-Based Learning for Foundation Computer Science Courses', *Computer Science Education*, vol. 10, no. 2, p 109-128

Khoo, HE 2003, 'Implementation of problem-based learning in Asian medical school and students' perceptions of their experience', *Medical Education*, vol. 37, no. 5, pp. 401-9, viewed 10th July 2007, Academic Search Premier, item AN 9925064

Kirsch, RP 1996, 'Teaching OLE Automation: A Problem-Based Learning Approach', *Proceedings of the twenty-seventh SIGCSE technical symposium on Computer Science Education,* ACM SIGCSE Bulletin, vol. 28, no. 1

Koppenhaver, GD & Shrader, CB 2003, 'Structuring the Classroom for Performance: Cooperative Learning with Instructor-Assigned Teams', *Decision Sciences Journal of Innovative Education*, vol. 1, no. 1, viewed 5th April 2007, Business Source Premier, item AN 9998372

Kreber, C 2001, 'Learning Experientially through Case Studies? A Conceptual Analysis', *Teaching in Higher Education*, vol. 6, no. 2, pp. 217-228, viewed 4th April 2005, Academic Search Premier, item AN 4421937

Krueger, RA 1998, *Moderating Focus Groups*, Sage Publications, Thousand Oaks, California.

Lagemann, EC 2002, *Usable Knowledge in Education: A Memorandum for the Spencer Foundation Board of Directors*, web page, Spencer Foundation, viewed 5th May 2006 at http://www.spencer.org/publications/usable_knowledge_report_ecl_a.htm

Lai, P & Tang, C 2000, 'Obstacles to the implementation of problem-based learning (PBL) in local universities of Hong Kong', *Proceedings of The 2nd Asia Pacific Conference on PBL*, Temasek Polytechnic, Singapore, 4-7 Dec.

Laurillard, D 1996, 'Teaching as Mediated Learning', in D Laurillard (ed.), *Rethinking University Teaching*, Routledge, London

Levin, P 2005, *Successful teamwork for undergraduates and taught postgraduates working on group projects*, Open University Press, Maidenhead, UK.

Little, AW 1997, 'The Value of Examination Success in Sri Lanka 1971-1996: The Effects of Ethnicity, Political Patronage and Youth Insurgency', *Assessment in Education: Principles, Policy and Practice*, vol. 4, no. 1, pp. 67-86, viewed 12th April 2005, Academic Search Premier, item AN 9704113615

Little, AW 2000, 'Globalisation, Qualifications and Livelihoods: towards a research agenda', *Assessment in Education: Principles, Policy and Practice*, vol. 7, no. 3, pp. 299-312, viewed 12th April 2005, Academic Search Premier, item AN 3978151

Litoselliti, L 2003, *Using Focus Groups in Research*, Continuum, London

Liyanaarachchi, C 2003, 'Sri Lanka Gets Jitters as Jobless Threaten Agitation', *OneWorld.net*, 17th September, p.1, viewed 20th May 2005 at http://amlat.oneworld.net/article/view/68255/1/
Madden, L, Lyle, D, Heading, G, Fuller, J, Trevena, L 2007: 'Can PBL be Applied in Postgraduate Public Health Education that is Delivered in the Service Environment', *Proceedings of Reinventing PBL - International Problem-Based Learning Symposium,* Republic Polytechnic, Singapore, 7-9 March, p.131-132
Madurapperuma, AP & Macan Markar DM 2006, 'Desirable Attributes for IT Graduates in Sri Lanka', *presented at SEARCC 2006*, 10-11 October, BMICH, Colombo, Sri Lanka.
Marcus, A & Gould, EW 2000, 'Crosscurrents - Cultural Dimensions and Global Web User-Interface Design', *Interactions*, vol. 7, no. 4, viewed 1st August 2005 at http://portal.acm.org/citation.cfm?id=345238&dl=GUIDE&coll=GUIDE&CFID=37207740&CFTOKEN=99440233.
Marincovich, M 2000, 'Problems and Promises in Problem-Based Learning', *Proceedings of 2nd Asia-Pacific Conference on Problem-Based Learning*, 4-7 Dec, Temasek Centre for Problem-Based Learning, Singapore.
Matthews, B 1995, 'University Education in Sri Lanka in Context: Consequences of Deteriorating Standards', *Pacific Affairs*, vol. 68, no. 1, pp. 77-94, viewed 19th July 2008 at http://www.jstor.org/stable/2759769?origin=JSTOR-pdf
Matthews, B 2004, 'Religious and Ideological Intransigence among the Sinhalese' in SH Hasbullah & BM Morrison (eds.), *Sri Lankan Society in an Era of Globalization : Struggling to Create a New Social Order*, Sage Publications Pvt Ltd., London
Maxwell, GS 1984, 'A Rating Scale for Assessing the Quality of Responsive / Illuminative Evaluations', *Educational Evaluation and Policy Analysis*, vol. 6, no. 2, pp. 131-138, viewed 13th April 2009, Sage Journals Online.
McCracken, M & Waters, R 1999, 'Why? When an otherwise successful intervention fails', *Proceedings of the 4th Annual SIGCSE/SIGCUE Conference on Innovation and Technology in Computer Science Education*, Krakow, Poland, pp. 9-12.
McGill, T 2003, *Current Issues in IT Education*, Idea Group Inc., London
MEHE 2004, *Recent Developments in Education in Sri Lanka*, press release, Ministry of Education & Higher Education, Battaramulla, Sri Lanka, viewed 6th September 2006 at http://www.moe.gov.lk/modules.php?name=Content&pa=showpage&pid=6#s223
Monday, A & Barker, S 2003, 'Developing Graduate Qualities', pp. 286-297, in T McGill (ed.), *Current Issues in IT Education*, Idea Group Inc., London
Morgan, DL 1998, *Planning Focus Groups*, Sage Publications, Thousand Oaks, California.
Mphande, C, Simcock, A, Shi, J, Bronson, P, & Ives, R 2007, 'Building Staff Awareness of Communication Education in the PBL Approach', *presented at the Reinventing PBL: International Problem-Based Learning Symposium*, Republic Polytechnic, Singapore, 7-9 March.
Munasinghe, L & Jayawardena, P 1999, 'Continuous Quality Improvement in Higher Education: a model for Sri Lanka', *Quality in Higher Education*, vol. 5, no. 1,

pp. 69-79, viewed 15th April 2005, Academic Search Premier, item AN 6194424
Nanayakkara, AGW 2004, *Employment and Unemployment in Sri Lanka - Trends, Issues and Options*, Department of Census and Statistics Sri Lanka, viewed 5th May 2005 at www.statistics.gov.lk/Reports/emp_unemp_in%20sri%20lanka.pdf
Nissanka, JS 2005, 'Social status, security and freedom entice graduates to public sector', *Sunday Observer*, 27th February 2005, viewed 21st July 2007 at www.sundayobserver.lk/2005/02/27/index.html
Nuradhi, M, & Kiswandono, I 2007: 'An Application of PBL for Studio Based Learning in Teaching Basic Design Concepts in Universitas Ciputra', *Proceedings of Reinventing PBL - International Problem-Based Learning Sympoasium*, Republic Polytechnic, Singapore, 7-9 March, p.134-149
O'Donnell, AM 1999, *Cognitive Perspectives on Peer Learning*, Rutgers Invitational Symposium on Education Series, Lawrence Erlbaum Associates Inc. Mahwah, New Jersey
Papinczak, T, & Young, L 2007, 'Peer Assessment in Problem-Based Learning: A Qualitative Study', *Advances in Health Sciences Education*, vol. 12, no. 2, pp.169-186, viewed 14th November 2007, SpringerLINK.
Patton, MQ 2002, *Qualitative Research & Evaluation Methods*, Sage Publications, Inc., Thousand Oaks, California
Perrenet, JC, Bouhuijs, PAJ, Smits, JGMM 2000, 'The Suitability of Problem-based Learning for Engineering Education: theory and practice', Teaching in Higher Education, vol. 5, no. 3
Pell, AR 1999, *Complete Idiot's Guide to Team Building*, Alpha Books, Indianapolis, Indiana
Polanco, R, Calderon, P, & Delgado, F 2001, 'Effects of a Problem-Based Learning Program on Engineering Students' Academic Achievements, Skills Development and Attitudes in a Mexican University', *presented at The Annual Meeting of the American Educational Research Association*, Seattle, WA, 10-14 April
Raheem, R 2006, 'Compliance or Deviation? Investigating English Medium Instruction in the Universities of Sri Lanka', *presented at the Invitational Symposium 2006: Language issues in English-medium Universities across Asia*, Hong Kong, viewed 30th August 2007 at www.hku.hk/clear/doc/DAY%201/Ryhana%20Raheem.ppt
Rama, M 1999, 'The Sri Lankan Unemployment Problem Revisited', *Policy Research Working Paper Series*, World Bank Development Research Group, viewed 5th June 2005 at http://econ.worldbank.org/docs/954.pdf
Reinhold, R 2006, *Personality Pathways - exploring personality type & its applications*, web page, viewed 5th May 2007 at http://www.personalitypathways.com/type_inventory.html.
Richards, C & Bhattacharya, M 2000, 'PBL and Towards an Integrated Framework for Information and Communication Technologies in Education', *presented at the 2nd Asia-Pacific Conference on Problem-Based Learning*, 5-7 Dec, Temasek Polytechnic, Singapore.
Riel, M 2000, 'White Paper: New Designs for Connected Teaching and Learning', *presented at the Secretary's Conference on Educational Technology 2000*, viewed 18th April 2003 at: http://www.gse.uci.edu/mriel/whitepaper/.

Roberts, TS 2006, *Self, Peer and Group Assessment in E-Learning*, Information Science Publishing, Hershey, Pennsylvania.

Rotberg, RI 1999, *Creating Peace in Sri Lanka: Civil War and Reconciliation*, Mass Belfer Center for Science and International Affairs, Cambridge, UK

Roth, RM & Wood, WC 1990, 'A Delphi Approach to Acquiring Knowledge from Single and Multiple Experts', *1990 ACM SIGBDP conference on Trends and directions in expert systems*, ACM, Orlando, Florida, 301-324.

Samaraweera, D 2007, 'Young people *gederata nakiwenawa* while governments think up solutions', *The Sunday Times Online*, 25th March, Colombo, viewed 11th November 2007 at sundaytimes.lk/070325/FinancialTimes/ft323.html

Sandoval, WA & Bell, P 2004, 'Design-Based Research Methods for Studying Learning in Context: Introduction', *Educational Psychologist*, vol. 39, no. 4, pp. 199-201, viewed 4th May 2006, Academic Search Premier, AN 14963084

Saunders, G & Klemming, F 2003, 'Integrating Technology into a Traditional Learning Environment : Reasons for and risks of success', *Active Learning in Higher Education*, vol. 4, no. 1, pp. 74-86, Sage Journals Online

Savin-Baden, M 2000, *Problem-based Learning in Higher Education: Untold Stories*, The Society for Research into Higher Education & Open University Press, Buckingham, UK

Savin-Baden, M & Howell-Major, C 2004, *Foundations of Problem-based Learning*, Open University Press, Oxford, UK

Shanker, PR 2006, 'Integrating subjects through problem-based learning: a South East Asian Perspective', *Medical Education Online*, vol. 12, viewed 4th April 2008 at http://www.med-ed-online.org/pdf/l0000015.pdf.

SLICTA 2005, *Geared for Growth: The Improving Stability of the Sri Lankan IT Workforce - National IT Workforce Survey*, Sri Lanka ICT Association, Colombo, Sri Lanka.

Slusarski, SB 1994, 'Enhancing Self-Direction in the Adult Learner: Instructional Techniques for Teachers and Trainers' in R Hiemstra & RG Brockett (eds.), *Overcoming Resistance to Self-Direction in Adult Learning*, Jossey-Bass Publishers, San Francisco, California

Snoke, R & Underwood A 2001, 'Generic Attributes of IS Graduates - A Comparison of Australian Industry and Academic Views', *Journal of Global Information Management*, vol. 9, no. 2, copy provided by author.

Speck, BW 2003, 'Fostering Collaboration Among Students in Problem-Based Learning' in DS Knowlton & DC Sharp (eds.), *Problem-Based Learning in the Information Age*, Jossey-Bass, San Francisco, California.

Stacey, E 2005, 'A Constructivist Framework for Online Collaborative Learning: Adult Learning and Collaborative Learning Theory' in TS Roberts (ed.), *Computer-Supported Collaborative Learning in Higher Education*, Idea Group Publishing, Hershey, Pennsylvania.

Stinson, JE & Milter, RG 1996, 'Problem-based learning in business education: Curriculum design and implementation issues' in L Wilkerson & WH Gijselaers (eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice*, Jossey-Bass, San Francisco, California.

Tambiah, SJ 1986, *Sri Lanka - Ethnic Fratricide and the Dismantling of Democracy*, University of Chicago Press, Chicago, Illinois.

Taylor, I & Burgess, H 1995, 'Orientation to Self-directed Learning - Paradox or Paradigm?', *Studies in Higher Education*, vol. 20, no. 1, viewed 9th Dec 2007, Academic Search Premier, AN 9506010246

Thiagarajan, S & Parker, G 1999, *Teamwork and Teamplay - Games and Activities for Building and Training Teams*, Jossey-Bass/Pfeiffer, San Francisco
Topping, K & Ehly, S 1998, *Peer-Assisted Learning*, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey.
Turner, R & Lowry, G 1999, 'Educating Information System Professionals: Towards a Reapproachment between New Graduates and Employers', *10th Australasian Conference on Information Systems*, Victoria University of Wellington, 1-3 Dec, pp.1049-1058
Warnapala, W 2008a, 'The Concept of the Entrepreneurial University and Sri Lanka', *presented at the Policy Dialogue on Higher Education in Sri Lanka and the United Kingdom*, 27th March 2008, Colombo, Sri Lanka.
Warnapala, W 2008b, 'Improving Quality of Undergraduate Education', *presented at the Seminar on Improving Relevance and Quality of Undergraduate Education (IRQUE)*, 5th September 2008, Colombo, Sri Lanka.
Warnapala, W 2009, 'Tertiary education and its relevance', *presented at the Association of Southeast Asian Institutes of Higher Learning (ASAIHL)*, 20th May 2009, Hendala, Sri Lanka.
Weathersby, R 1993, 'Sri Lankan Managers' Leadership Conceptualizations as a Function of Ego Development' in J Demick & PM Miller (eds.), *Development in the Workplace*, Lawrence Erlbaum Associates, New York.
Weiss, RE 2003, 'Designing Problems to Promote Higher-Order Thinking', in DS Knowlton & DC Sharp (eds.), *Problem-Based Learning in the Information Age*, Jossey-Bass, San Francisco, California.
Wells, CE 2002, 'Teaching Teamwork in Information Systems', in E Cohen (ed.), *Challenges of Information Technology Education in the 21st Century*, Idea Group Publishing, Hershey, Pennsylvania.
Wen, ML & Tsai, C-C 2006, 'University students' perceptions of and attitudes towards (online) peer assessment', *Higher Education*, vol. 51, no. 1, pp. 27-44, viewed 8th August 2007, Academic Search Premier, item AN 19508987
West, MA 2004, *Effective Teamwork - Practical Lessons from Organizational Research*, BPS Blackwell, Leicester, UK
Wiersma, W 2000, *Research Methods in Education - An Introduction*, Allyn and Bacon, Boston
Wijesinha, R 2003, 'Bringing Back the Bathwater: New Initiatives in English Policy in Sri Lanka' in C Mair (ed.), *The Politics of English as a world language : new horizons in postcolonial cultural studies*, Rodopi, San Francisco, California.
Wilkerson, L 1996, 'Tutors and Small Groups in Problem-Based Learning: Lessons from the Literature' in L Wilkerson & WH Gijselaers (eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice*, Jossey-Bass Publishers, San Francisco, California.
World Bank 2003, *Sri Lanka - Improving Relevance and Quality of Undergraduate Education*, Project Information Document, World Bank, Washington, viewed 10th May 2003 at http://www-wds.worldbank.org
World Bank 2004, *Treasures of the Education System in Sri Lanka*, press release, World Bank, Human Development Sector Unit, South Asia region, viewed 10th June 2007 at http://siteresources.worldbank.org
World Bank 2006, *Implementation Completion Report (IDA-30140) on a Credit in the amount of SDR51.4Million (US$70.3 million) to the Democratic Socialist Republic of Sri Lanka for a Second General Education Project*, report, World

Bank, Human Development Sector Unit, South Asia region, viewed 20th November 2006 at http://www-wds.worldbank.org
World Bank 2007, *Country Summary of Higher Education*, report, viewed 23rd November, 2007 at http://siteresources.worldbank.org
Yutdhana, S 2005, 'Design-Based Research in CALL' in JL Egbert (ed.), *CALL Research Perspectives*, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey, pp.169-178.

Appendix A

(Paper presented at SEARCC 2006 ICT Conference, 10-11th October, Colombo)

Desirable Attributes for IT Graduates in Sri Lanka

Dr. Ajith P. Madurapperuma
Dean, Faculty of Information Technology, University of Moratuwa, Sri Lanka

Deborah Macan Markar
Doctoral Candidate, University of Southern Queensland, Australia

ABSTRACT
The 2005 National IT Workforce Survey and the earlier SEARCC-sponsored ICT Manpower Survey raised concerns about the soft skills of IT graduates. The Faculty of Information Technology at the University of Moratuwa found that similar concerns were frequently echoed in their consultations with industry leaders and decided to undertake a comprehensive survey of employer attitudes towards graduate attributes or soft skills. 45 employers responded to the survey. For the purposes of comparison, the initial list of attributes was based on a earlier (1998-99) study sponsored by the ACS in Australia. However the research design provided for additional attributes to be added at the suggestion of Sri Lankan employers.

Soft skills such as teamwork, problem-solving skills and a commitment to lifelong self-learning were found to be important to employers with a lesser emphasis on content knowledge. This is consistent with international trends. However Sri Lanka employers were far more concerned with employee attitudes and disposition than their Australian counterparts. Surprisingly, oral and written communication skills were deemphasized in the Sri Lankan study. At entry level, employers are looking for graduates who can comprehend oral and written instructions but not necessarily people who can give effective presentations or write impressive reports.

1. INTRODUCTION

The Faculty of Information Technology (FIT), University of Moratuwa was established in June 2001 to train Information Technology graduates to meet the demands of the local business sector. In this identity, FIT's role and mission complements that of the long established Department of Computer Science of the Faculty of Engineering at Moratuwa. To ensure that the Faculty continues to be responsive to the needs of the Sri Lankan ICT[1] industry it has undertaken a number of industry partnering initiatives including in-plant training activities and consultations with industry regarding syllabus revisions. This paper describes one such initiative – a pilot survey of employers from the local ICT industry which seeks to establish the generic attributes employers expect or would like new graduates in their employ to have.

The 2005 National IT Workforce Survey conducted in Sri Lanka by SLICTA [3] gave some early indications of a gap between the skills desired by employers and the skills with which new graduates entered the workforce. "Employers see many shortfalls in level of skills in new employees. Notably, they are soft skills; a number of which are taught in many courses above diploma level" [3]. Figure 1 shows the primary and secondary skills regarded as most important by ICT employers consulted by SLICTA. While employer responses differed widely on technical skills required, they consistently listed key soft skills – albeit usually as a secondary skill requirement. In contrast, the training institutions consulted rarely

[1] Information and Communication Technology

mentioned soft skills as an important part of their curriculum.

Unfortunately, reference to an earlier survey conducted by the CSSL as part of a SEARCC-sponsored Regional ICT Manpower Survey in 2000/2001 indicates that the situation has not improved in the intervening 5 years. That survey concluded that "Graduates demonstrate a high level of domain/technical knowledge absorption, but do not fare significantly better in many other skills. With respect to Interpersonal skills and work attitude, their absorption is lower than that of non-degree holders. In contrast, foreign graduates outperform non-graduates in the absorption of all skills listed, as perceived by the respondents" [2].

The sentiments expressed by employers in the SLICTA survey and the earlier CSSL survey are constantly echoed in private conversation with industry representatives and were the motivating force for the current survey. This study is partially based on a 1998/1999 study conducted in Australia under the auspices of the Australian Computer Society to identify the generic attributes desired by employers of ICT graduates. [4]. The Snoke & Underwood study itself was conducted in response to findings from other studies conducted in Australia and the US which suggested that a disparity exists between what employers perceive as important graduate attributes and the generic attributes that graduates and academics perceive to be important demonstrating that the gap is not just a Sri Lankan phenomenon. While the study conducted by Snoke and Underwood targeted both academics in Australian universities and industry participants from the Australian Computer Society (ACS) membership list, the current study targeted industry representatives exclusively. This reflects FIT's focus on keeping abreast of changing industry needs.

1.1 Participants

The initial rounds of the study were conducted between June and Sept in 2004. A pool of 37 potential participants were identified from amongst industry representatives who already work closely with FIT together with an additional 18 industry representatives who are members of the Sri Lankan Software Exporters Association and named on their web site. This gave a total of 55 potential respondents to be approached. Of these 55, 27 responded to this first round of the survey giving a participation rate of 49%. In July 2006 the survey was sent out to 60 additional respondents in order to increase the sample size and validate some of the responses which were not felt to be consistent with anecdotal evidence. After this round, the total sample size increased to 45.

1.2 Research Method

Snoke and Underwood defined generic attributes as "competencies that a graduate possesses upon completion of a tertiary degree" [4]. For their Australian study they asked participants to respond to a list of attributes compiled by the Generic Attributes Working Party at the Queensland University of Technology (Australia) and validated through a pilot study and later a Queensland-wide survey. This same list of attributes was used as the basis for the current study so that comparisons could be drawn. However Sri Lankan respondents were encouraged to make comments and to suggest additional attributes as they saw fit. It was expected that this approach would generate competencies of importance to the Sri Lankan context that may not have been included in the Australian study.

Following Snoke and Underwood, the Delphi technique for gaining consensus amongst a diverse group of individuals was used as the research methodology. The Delphi technique commonly involves asking participants to rate or rank a series of attitudinal statements. Summary statistics (means/medians/standard deviations) are then calculated and this information returned to respondents to allow them to change or reaffirm their ratings/rankings. The process is continued until consensus is achieved or until trends are obvious. Two or three round surveys are common.

In the first round of this study a questionnaire was emailed to the identified participants asking them to rate 28 generic attributes identified by the Australian study on a scale of 1 - 7.

1 = extremely unimportant,
2 = unimportant,
3 = of little importance,
4 = neutral,
5 = very important,
6 = of major importance,
7 = extremely important (essential).

Space was provided at the end of the questionnaire for respondents to make any comments they desired or to add additional attributes that they thought should be included.

Respondents were asked to use the reply function on their e-mail package to complete the questionnaire. In Australia this allowed the researchers to achieve very short turn around times of around 14 days. In the Sri Lankan study many responses were received within a few days but tardy participants were, in some cases, still sending back responses 25 days after the initial mailing. Several rounds of reminder notices were sent to participants who failed to respond to each round of the survey.

After the first round, summary statistics (sample means) were calculated and the survey resent to both those participants who responded to round one and those who did not.

In the questionnaire for the second round, the mean rating for each attribute from the first round was recorded and participants again asked to rate all attributes. Participants were also asked to respond to an additional seven attributes suggested by respondents to the first round.

Summary statistics were then calculated based on the responses to the second round and a third questionnaire sent to both respondents and non-responding participants. An additional five attributes were added to the questionnaire for round three as the result of suggestions made by respondents to round two.

Only 4 participants responded to all three rounds with 9 participants responding to at least two rounds. Many of those who did respond to multiple rounds did not change their ratings based on the information about rating means recorded on subsequent survey forms. This was consistent with findings by Snoke and Underwood who noted that 50% of their respondents did not change their minds about ratings between rounds. Based on these findings, it is unlikely that any significant degree of consensus was achieved through the survey. However the using a survey design that collected responses through multiple rounds did allow several useful attributes to be added to the list with participant responses collected in subsequent rounds. While it is possible that the responses of those who participated in only one round of the survey were influenced to some extent by means recorded for previous rounds, it would be safer to regard survey findings as the results of a once only poll rather than a consensus.

With such a small sample size the validity of mean and other values of central tendency can be questioned as one or two outlier values can markedly alter the value of the sample mean. With larger sample sizes such as that used for Snoke and Underwood's Australian study, the impact of these outlier values would be masked. Consequently, as a cross-check to identify sample means which may have been unduly influenced by outlier values, attributes were ranked according to the percentage of respondents who rated the attribute as either *Extremely Important (Essential) - 7* or *Of Major Importance - 6* and this ranking compared to the ranking of attributes by mean values.

The intent of the current small-scale study is merely to suggest trends and to identify questions and possible methodologies for further research. By round three, the survey instrument used had evolved from one based on attributes validated in the Australian study into something with a particularly Sri Lankan flavour. In order to validate the final instrument for the purposes of future research efforts, Cronbach α coefficients were calculated for logically and empirically grouped attribute measures. These findings are included as a guideline pending more rigorous factor analysis with larger sample sizes.

2. RESULTS

Table 1 shows the ranking of attributes based on rating means from the current study with a comparison given for ratings from the Australian study for those attributes surveyed in common. Listed rankings are based on responses of participants to the final round of the survey to which they responded. Attributes generated by Sri Lankan employers and not found in the Australian study are marked as 'SL' in the table. Several attributes were dropped from the study after receiving consistently low ratings in earlier rounds. These are marked as such in the table.

To assess the impact of outlier values on sample means, the percentage of employers who rated each attribute as either 7 – *Extremely Important (Essential)* or 6 – *Of Major Importance* is recorded in Table 2 and the ranking derived in this way compared with a ranking based on mean values. The ranking of attributes using both measures was found to be highly correlated with a correlation coefficient of 0.965. Moreover, the spread of responses is quite even, suggesting that values of 6 or 7 should not be regarded as outlier values but rather as indications of strength of response by particular employers. Attributes for which rankings either increased or decreased markedly using this approach are noted using a ↑ or ↓ symbol in the table.

The results initially suggest that Sri Lankan employers are looking for completely different generic attributes when they conduct job interviews with new graduates than their Australian counterparts. Of the five attributes rated most highly by Sri Lankan employers[2], four are Sri Lanka specific. All five of the top ranking attributes are individual personality traits or attitudes likely to impact on work performance. Top of the list is *Accuracy and attention to detail*. This is followed by *Possess a 'can-do' attitude*, then *Be highly committed to one's work*, and finally a *Willingness to accept constructive criticism*. These and other personal characteristics were initially included in the attribute list based on comments made by a respondent regarding the limitations of Sri Lankan university graduates as employees. The high ratings accorded to these attributes by other employers would appear to endorse the validity of his comments. Using sample means as a basis of comparison, the only top-ranking attribute sourced from the Australian study was *Self-motivation* - another individual personality trait. However if percentage of employers rating a trait as 'Of major importance' or 'Essential' is used as the indicator, the attribute *Work as part of a team in a productive and cooperative manner* achieves a ranking of 2nd place – a direct parallel with the Australian study and the attribute *Considers the quality of the solution and its timeliness* is also listed among the top five attributes.

Beyond the focus on personality traits, a number of parallels between the findings of the Sri Lankan and Australian studies are evident although findings are possibly not as close as might have been expected. The correlation between the rankings of attributes in the two studies was 0.68 after ignoring the Sri Lanka specific attributes.

As mentioned above, the ability to *Work as part of a team in a productive and cooperative manner*, ranked in second place by Australian employers, was also rated highly by Sri Lankan employers. This reflects the nature of the work environment in the ICT industry

[2] Unless otherwise specified, ratings and rankings are taken from Table 1 and based on sample means.

worldwide where there is a heavy emphasis on teamwork.

The attribute *Willingness to embrace change and to engage in incremental improvement to keep up with the rapid change in* technology ranked 13th in the Australian study, was rated 9th in this study[3]. This also reflects an internationally recognized characteristic of the industry - rapid change and the need for employees to be committed to ongoing professional development to keep abreast of change. Other closely related traits also scored highly:

- *Willingness to participate in ongoing professional development* (ranked 16th in the Sri Lankan study and 19th in the Australian),
- *Willingness to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.* (ranked 10th in the Sri Lankan study and 1st in the Australian study).

If one considers the percentage of employers rating attributes as 6-*Of Major Importance* or 7-*Extremely Important (Essential)*, further parallels present themselves although again a number of seemingly culture-specific individual characteristics volunteered by Sri Lankan employers come to the fore. These latter include, *Being well organised and well disciplined*, *Ability to comprehend oral and written instructions* and the *Ability to think and act rationally.*

An interesting parallel between the two studies is the relatively low emphasis placed on ICT content knowledge. Possessing a *Coherent, extensive, theoretical and practical knowledge* is ranked 14th in the Australian study and roughly equivalent (19th) in the current study, with other knowledge related attributes scoring even more poorly. Demonstrating *Practical knowledge and understanding in at least one computer language* is ranked at position 23 - again roughly equivalent to its ranking in the Australian study). *Theoretical and practical knowledge in at least one reference discipline* has a very low mean rating (5.67).

Following the same pattern as the Australian study, Sri Lankan employers tended to regard Business Knowledge attributes (attributes relating to an understanding of how a business operates) as unimportant. The attribute, *Understand that businesses are first and foremost revenue generating enterprises and have a personal commitment to that* ranked 29th while the attributes, *Knowledge of how a business operates, is structured and is orientated* and *Understanding the profit motive of business* were dropped from the study prior to the third round because of low ratings. It is likely that employers understand that it is unrealistic to expect graduates to develop this sort of knowledge and understanding in the university environment. While they are desirable attributes, they will be developed once the graduate becomes part of the business world.

One interesting anomaly between the two studies is the perceived importance of communication skills. *Oral communication skills,* ranked 4th in the Australian study, appeared only in 24th place in the Sri Lankan study; *Written communication skills* were ranked 30th in the Sri Lankan study compared to 9th in the Australian study. However *Ability to comprehend oral and written instructions* – a new attribute volunteered by a Sri Lankan employer - was ranked 14th by his fellow respondents (and was very frequently given a rating of 6 or 7 by employers – a ranking of 6th place on this scale). Anecdotal evidence suggests that most new ICT graduates in Sri Lanka obtain work initially as programmers and that it was this that employers had in mind when asked to comment about "generic attributes required of **entry level** employees" (quote from survey form). Hence while the ability to make presentations to clients or to produce

[3] Note that since the Australian study included only 28 attributes while the current study included 40, rankings cannot be directly compared.

clear, well-written reports may be skills required as one's career progresses, they are not skills that employers are concerned about at entry level.

This desire to recruit new graduates who are willing and capable of taking direction may also explain the relatively low importance given to problem-solving skills in comparison with the results of the Australian survey. The attribute *Considers the quality of the solution and its timeliness* was ranked quite highly. However general problem solving skills were regarded as being far less important with *Ability to analyse, synthesise and evaluate the various solutions* and *Defines Problems in a systematic way* and *Ability to retrieve, evaluate and use relevant information* being ranked towards the middle of the listing. In the Australian study these attributes were ranked towards the top of the list.

3. CONCLUSIONS AND DISCUSSION

Many of the findings of the current study reflect those of Snoke and Underwood's Australian study as well as other studies conducted in that country. However there are some notable exceptions to this, which can be linked back to the different social and work cultures of the two countries.

As was the case with the Australian study, the current study found that,

1. ICT knowledge related skills were not as important to employers as having the right attitude and good work skills.
2. Employers were looking for team players consistent with the industry's emphasis on teamwork solutions.
3. Employers were looking for graduates who were keen to continue learning throughout their career. While ongoing professional development is an important component of most career paths these days, this is essential in the ICT field which is characterized by rapid change.
4. Employers were not unrealistic enough to expect new graduates who may have had limited exposure to commerce to have a sense of the business world. Business knowledge attributes were regarded as less important and presumably something which would develop with experience.

Sri Lankan employers appear to be more concerned with the attitudes and work skills of the people they employ and the personal characteristics they are looking for are different to those generated by the Australian study. Anecdotal comments made by respondents suggest that these concerns stem not only from differences in the Sri Lankan culture per se but also from employer concerns about Sri Lankan university graduates. They are consistent with the findings of the CSSL ICT Manpower and Skills Survey where it was reported that non-degree holders generally outperformed degree holders in their absorption of key soft skills such as Interpersonal Skills and Work attitude [2].

Secondly, oral and written communication skills were deemphasized in the Sri Lankan study. Employers are looking for graduates who can *comprehend oral and written instructions* but not necessarily people who can give effective presentations or write impressive reports. This fits in with the emphasis of the study on entry-level skills; graduates entering the ICT workforce in Sri Lanka are most likely to do so as programmers where they have limited client contact. Problem solving skills were also deemphasized indicating that employers place higher value on new employees who can take direction rather than take initiative.

Interestingly a recent study by Lowry and Turner of the Victoria University in Australia also found that "The findings indicate that employers want new graduates who will be immediately productive at relatively low level work …..(They) seem to want graduates who can accept their position within an organization and accept direction. Teamwork, the ability to learn new skills and other personal attributes, except for the knowledge of programming languages, appear to be more important to employers than specific academic skills…...” [5] These expectations were very different to the expectations of the ICT students they surveyed. Snoke and Underwood’s study also identified significant discrepancies between the views of academics and employers responding to their survey. Unless students keep in mind that it is the function of universities to help them prepare themselves beyond their initial work placements into the short to middle terms of their career development, it is possible that this sort of disparity between employer expectations and the skills and knowledge thought to be important by academics and students will become a source of frustration and disappointment for new graduates both in Australia and Sri Lanka.

These results are broadly consistent with the 2000/2001 ICT Manpower and Skills Survey in which employers consistently rated IT professionals In their employ between ‘Basic’ and ‘Competent’ for key soft skills such as Creative thinking skills, Interpersonal skills, and Presentation skills [2]. Five years later, in its National IT Workforce Survey, SLICTA asked employers to list the 5 main skill deficiencies noted in new recruits for different job categories (Refer Table 3). Based on the number of soft skills mentioned, the fact that training institutions underemphasize the development of soft skills, and the frequency with which employers judged new recruits to be deficient in technical skills in which they have purportedly been trained, the report concluded that “The focus of the training organizations needs to shift now to increasing the overlap between what is required and what is taught” [3].

The Faculty of Information Technology, University of Moratuwa (FIT) is currently adapting its courses to increase this overlap. FIT has recently revised its syllabus integrating content taught in some programming units into other subjects making way for the introduction of cutting edge technologies in subjects such as agent based systems, robotics and bioinformatics and strengthening areas related directly to business such as accounting, management and quality assurance. It is also trialing the introduction of Problem Based Learning (PBL) where the emphasis is on working in teams to solve real-world problems. With a PBL approach, students are exposed to real clients early in their course of study; they no longer learn theory in isolation but as they need to know it in order to solve the sorts of problems they will face when they enter the industry. Lecturers provide support not only with syllabus content but with the sorts of skills students will need to be effective team workers and self-reliant, independent learners after graduation.

4. DIRECTIONS FOR FURTHER STUDY

The current study has been conducted by FIT as a means of getting in touch with what Sri Lankan employers in the ICT field are looking for in new employees. By replicating aspects of an Australian study, the findings can be put into an international perspective. However there would be value both in repeating the study on a larger scale and in extending it to include a survey of academics and students in Sri Lankan universities.

To this end, an analysis of the final version of the survey instrument (following the addition of locally generated attributes) was conducted to identify which indicators might profitably be included in a future questionnaire. While the low sample size of the current study did not make it possible to conduct a factor analysis[4], it would appear from the high degree of intra-correlation between nominated attributes that the study effectively measured employer attitudes to some 6 broad components. Cronbach alpha coefficients were calculated for attributes thus categorized and are given in Table 4. Attributes which

[4] "It is generally unwise to conduct a factor analysis on a sample of fewer than 50 observations." (The University of Texas at Austin Statistical Services, 1995)

appeared to logically measure the same thing but which were not positively correlated were dropped.

ACKNOWLEDGEMENT
We would like to thank Dr Robert Snoke of Central Queensland University for his support and assistance which allowed us to reference this study to that undertaken by Snoke and Underwood for the ACS.

REFERENCES

1) ACITS, The University of Texas at Austin Statistical Services (1995-1997): *Factor Analysis Using SAS PROC FACTOR*, Available online at: http://www.utexas.edu/cc/docs/stat53.html

2) Computer Society of Sri Lanka (2000/2001): *Information and Communications Technology Manpower and Skills Survey Sri Lanka 2000/2001*, conducted by CSSL for SEARCC as part of the Regional ICT Manpower Survey.

3) Sri Lanka ICT Association (2005): *Geared for Growth: The Improving Stability of the Sri Lankan IT Workforce,* National IT Workforce Survey, SLICTA

4) Snoke, R & Underwoord A. (2001): *Generic Attributes of IS Graduates - A Comparison of Australian Industry and Academic Views*, Journal of Global Information Management Vol 9 (No. 2), p 33-40

5) Turner, R. & Lowry, G (1999): *Education Information Systems Professionals: Towards a Reapprochement Between New Graduates and Employers*, Proceeding of the 10th Australiasian Conference on Information Systems, 1049 – 1058.

FIGURES AND TABLES REFERRED TO IN THE TEXT

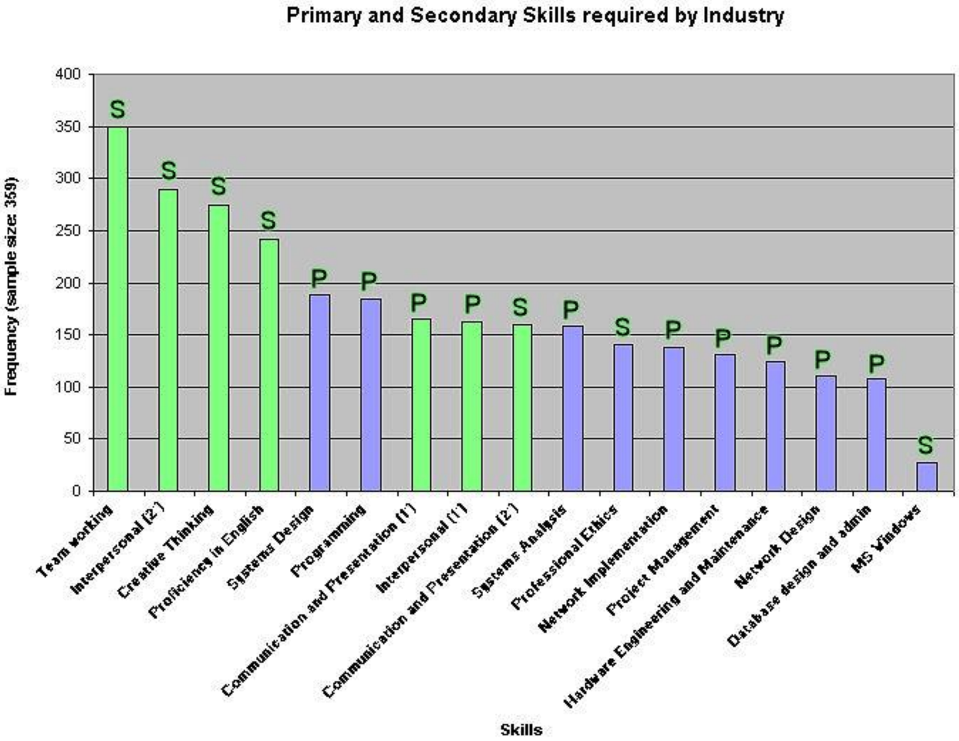


Figure 1: Primary and Secondary Skills required by ICT industry employers in Sri Lanka (SLICTA 2005. Adapted from Table 7, p23 ‘P’ indicates a primary skill and ‘S’ a secondary skill).

Graduate Attributes	Mean Rating Sri Lankan Study	Ranking Australian Study*	Ranking Sri Lankan Study
Accuracy and attention to detail[SL].	6.60	-	**1**
Posses a 'can do' attitude[SL].	6.57	-	**2**
Self-motivation.	6.56	6	**3**
Be highly committed to one's work[SL].	6.55	-	**4**
Willingness to accept constructive criticism[SL].	6.53	-	**5**
Work as part of a team in a productive and cooperative manner	6.47	2	**6**
Considers the quality of the solution and its timeliness.	6.36	10	**7**
Being well organised and well disciplined[SL].	6.33	-	**8**
Willingness to embrace change and to engage in incremental improvement to keep up with the rapid change in technology	6.31	13	**9**
Willingness to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.	6.29	1	**10**
Willingness to take direction from more experienced colleagues even though that person may not have a university qualification[SL].	6.23	-	**11**
Confidence about their ability to learn independently	6.22	15	**12**
Ability to think and act rationally[SL].	6.21	-	**13**
Ability to comprehend oral and written instructions[SL].	6.20	-	**14**
Interpersonal skills	6.16	8	**15**
Willingness to participate in on-going professional development	6.13	19	**16**
Ability to analyse, synthesise and evaluate the various solutions	6.11	7	**17**
Defines problems in a systematic way	6.07	5	**18**
Coherent, extensive, theoretical and practical knowledge	6.04	14	**19**
Possess a sense of basic curiosity about technology	6.00	23	**20**
Ability to retrieve, evaluate and use relevant information	5.98	3	**21**
Time management skills	5.96	17	**22**
Demonstrates practical knowledge and understanding in at least one computer language.	5.96	22	**23**
Oral communication skills.	5.91	4	**24**
Ability to reflect on own strengths and weaknesses	5.91	20	**25**
Values the ethics of the Information Technology profession	5.84	12	**26**
Ability to work independently	5.80	16	**27**
Good written and spoken English language skills[SL].	5.75	-	**28**
Understand that businesses are first and foremost revenue generating enterprises and have a personal commitment to that[SL].	5.75	-	**29**

Graduate Attributes	Mean Rating Sri Lankan Study	Ranking Australian Study*	Ranking Sri Lankan Study
Written communication skills	5.74	9	**30**
Ability to adapt the theory to the business environment[SL].	5.69	-	**31**
Technological competence (the person is able to use the current technology competently)	5.69	11	**32**
Theoretical and practical knowledge in at least one reference discipline.	5.67	18	**33**
Possess a confident and outgoing personality[SL].	5.59	-	**34**
Ability to adapt to unfamiliar cultures and operate in a socially and culturally diverse environment.	5.49	25	**35**
Research skills	5.47	27	**36**
Sensitivity to differences in gender, culture and customs	5.31	21	**37**
Understanding of the profit motive of business	Dropped	28	**38**
Knowledge of how a business operates, is structured or is orientated	Dropped	24	**39**
Theoretical and practical knowledge of related disciplines. For example, business, law, education, political science or behavioural science.	Dropped	26	**40**

* As the Australian study included only 28 attributes, rankings cannot be compared directly but only in terms of order of magnitude.

Table 1: Generic attributes ranked by mean ratings.

Graduate Attributes	Percentage Employers rating attribute as "Extremely Important (Essential)" or "Of Major Importance"	Rank Order by percentage rating 6/7	Rank Order by Mean
Self-motivation	95.56%	1	3
Work as part of a team in a productive and cooperative manner	93.33%	2 ↑	6
Accuracy and attention to detail	93.33%	2	1
Considers the quality of the solution and its timeliness.	88.89%	4	7
Willingness to accept constructive criticism.	88.89%	4	5
Be highly committed to one's work.	86.67%	6	4
Being well organised and well disciplined	86.67%	6	8
Ability to comprehend oral and written instructions	86.67%	6 ↑	14
Ability to think and act rationally	85.71%	9 ↑	13
Willingness to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.	84.44%	10	10
Posses a 'can do' attitude.	84.44%	10 ↓	2
Confidence about their ability to learn independently	82.22%	12	12
Willingness to embrace change and to engage in incremental improvement to keep up with the rapid change in technology	80.00%	13 ↓	9
Interpersonal skills	80.00%	13	15
Willingness to take direction from more experienced colleagues even though that person may not have a university qualification.	80.00%	13	11
Defines problems in a systematic way	77.78%	16	18
Ability to analyse, synthesise and evaluate the various solutions	77.78%	16	17
Time management skills	75.56%	18 ↑	22
Willingness to participate in on-going professional development	75.56%	18	16
Coherent, extensive, theoretical and practical knowledge	73.33%	20	19
Ability to retrieve, evaluate and use relevant information	73.33%	20	21
Demonstrates practical knowledge and understanding in at least one computer language.	73.33%	20	23
Oral communication skills.	73.33%	20 ↑	24
Ability to reflect on own strengths and weaknesses	71.11%	24	25

Graduate Attributes	Percentage Employers rating attribute as "Extremely Important (Essential)" or "Of Major Importance"	Rank Order by percentage rating 6/7	Rank Order by Mean
Possess a sense of basic curiosity about technology	71.11%	24 ↓	20
Ability to adapt the theory to the business environment	69.23%	26 ↑	31
Ability to work independently	64.44%	27	27
Theoretical and practical knowledge in at least one reference discipline.	62.22%	28 ↑	33
Values the ethics of the Information Technology profession	62.22%	28	26
Good written and spoken English language skills.	62.22%	28	28
Understand that businesses are first and foremost revenue generating enterprises and have a personal commitment to that.	57.78%	31	29
Technological competence (the person is able to use the current technology competently)	55.56%	32	32
Written communication skills	53.33%	33	30
Ability to adapt to unfamiliar cultures and operate in a socially and culturally diverse environment.	53.33%	33	35
Research skills	51.11%	35	36
Possess a confident and outgoing personality	51.11%	35	34
Sensitivity to differences in gender, culture and customs	42.22%	37	37
Theoretical and practical knowledge of related disciplines.	0.00%	38	40
Knowledge of how a business operates, is structured or is orientated	0.00%	39	39
Understanding of the profit motive of business	0.00%	40	38

Table 2: A comparison of attribute rank ordering using strength of response indicators

Job Category required by Industry#	5 main Skill Deficiencies noted in New Recruits
Database Administration and Development	Database design and administration (28%) **Interpersonal (27%)** **Communication and Presentation (27%)** **Creative thinking (23%)** Systems Design (21%)
Enterprise System Consulting	Business analysis and process engineering (28%) Systems Analysis (26%) **Communication and Presentation (32%)** **Creative Thinking (30%)** Project Management (23%)
Network Design and Administration	Network implementation (36%) Network Design (32%) Internet and Systems security (26%) **Interpersonal (25%)** **Communication and Presentation (25%)**
Software Engineering	System Design (31%) Programming (27%) **Creative thinking (28%)** **Interpersonal Skills (22%)** **Communication and Presentation (25%)**
Project Management	Project Management (28%) **Communication and Presentation (32%)** **Interpersonal (45%)** **People and organizational change management skills (32%)** Business analysis and Process Engineering (25%)
Quality Assurance	System / applications testing (20%) **Interpersonal skills (30%)** Systems Analysis (16%) **Creative thinking (41%)** **English language proficiency (30%)**
IT Management	**People and organisational change (32%)** **Communication and Presentation (35%)** **Interpersonal (31%)** Business analysis and process engineering (26%) **Creative thinking (35%)**

Note: Only those job categories where more than 40% of employers looked for graduate qualifications are shown.

Table 3: Skill deficiencies in new recruits according to Sri Lankan IT employers (SLICTA 2005, adapted from figures quoted in chapter 5)

COMPONENT	ATTRIBUTE	Cronbach's Alpha Coefficient
Personal Characteristics / Attitudes	Self-motivation	0.8805
	Be highly committed to one's work.	
	Willingness to accept constructive criticism	
	Accuracy and attention to detail	
	Confidence about their ability to learn independently	
	Interpersonal skills	
	Willingness to take direction from more experienced colleagues even though that person may not have a university qualification.	
	Being well organised and well disciplined	
	Ability to comprehend oral and written instructions	
	Ability to work independently	
Commitment to Ongoing Professional Development	Willingness to embrace change and to engage in incremental improvement to keep up with the rapid change in technology	0.7854
	Willingness to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.	
	Willingness to participate in on-going professional development	
Problem-solving Skills	Defines problems in a systematic way	0.7742
	Considers the quality of the solution and its timeliness.	
	Ability to retrieve, evaluate and use relevant information	
	Ability to analyse, synthesise and evaluate the various solutions	
Communication Skills	Oral communication skills.	0.8276
	Good written and spoken English language skills.	
	Written communication skills	
Business Knowledge	Understand that businesses are first and foremost revenue generating enterprises and have a personal commitment to that.	**
	Knowledge of how a business operates, is structured or is orientated	
	Understanding of the profit motive of business	
Cultural and ethical awareness	Ability to adapt to unfamiliar cultures and operate in a socially and culturally diverse environment.	0.7895
	Sensitivity to differences in gender, culture and customs	
	Values the ethics of the Information Technology profession	

** Coefficient could not be calculated as 2 of 3 factors were dropped from the analysis in Round 2

Table 4: Components measured by the survey instrument

APPENDIX B : Instruments

- ❖ Higher order learning skills in-class test (baseline)
- ❖ Focus group discussion guides 2004 – 2007
- ❖ Course Experience Questionnaire 2004 – 2007
- ❖ Student reflection assignments.

LakSoft Proposal to

InfoSVC Corporation and Empresas Española de Informática*

(* Higher order learning skills in-class test)

Consider the following scenario. LakSoft (Pvt) Ltd has been established by a group of local software engineers. So far all of LakSoft's work has been for local clients but they are interested in getting into the more lucrative international market. LakSoft has participated in several trade fairs to market their services to large foreign clients. Their efforts have finally paid off. They have received expressions of interest from a large American company (InfoSVC Corporation) and a medium size Spanish company (Empresas Española de Informática).

The Spanish company is involved in developing device drivers in C language and requires the interface to their systems be bi-lingual, i.e. Spanish and English. This is a new area of work for LakSoft. InfoSVC Corporation are interested in negotiating a Memorandum of Understanding for ongoing outsourcing of their web design and development work to LakSoft if the pricing is competitive. LakSoft has already gained something of a reputation for its work in developing Java applets for local websites and hopes to be able to build on its expertise in this area.

Each company has prepared a software requirements document for the proposed work. They have requested LakSoft to submit their skills matrix outlining the skills available among the employees and to prepare a cost estimate.

LakSoft has realized they do not have the in-house experience to prepare a cost estimate. They have requested the assistance of the University to prepare a cost estimate for each of the clients and to recommend the costing model they should use. The University in turn has decided to use you as a research assistant to collect the necessary information and prepare a report so that the consultant in charge can prepare the costing component of the report that LakSoft will be submitting to the client. LakSoft has arranged for you to interview a representative from each of these clients via telephone to clarify any queries that you may have in preparing your report. As this will involve expensive international calls, LakSoft insists that you prepare yourself before the interviews to make the best use of the time available.

You will also be provided with a copy of the requirements documents and you will have the opportunity to interview the CEO of LakSoft (Pvt) Ltd.

Your task:

(i) Prepare a set of questions that you would ask the representative of *InfoSVC Corporation*.

(ii) Prepare a set of questions that you would ask the representative of *Empresas Española de Informática.*

(iii) Prepare a list of things that you would look for as you read the requirements document.

(iv) Prepare a set of questions that you would ask the CEO of LakSoft.

IN EACH CASE, WRITE DOWN THE REASON THAT YOU WOULD ASK THE QUESTION.

NOTE: List of URL resources given to students (recorded on CD)…students were particularly directed to 1, 2 and 8

1. http://ksi.cpsc.ucalgary.ca/courses/451-96/mildred/451/CostEffort.html
2. http://sern.ucalgary.ca/courses/seng/621/w98/johnsonk/cost.htm
3. http://www.jsc.nasa.gov/bu2/PCEHHTML/pceh.htm
4. http://www2.andrews.edu/~vyhmeisr/papers/costest.html
5. http://paginaspersonales.deusto.es/cortazar/doctorado/articulos/leung-handbook.pdf
6. http://www.it.lut.fi/opetus/99-00/010758000/notes/lecture12.pdf
7. http://fast.faa.gov/pricing/c1919-5.htm#19.5
8. http://sunset.usc.edu/publications/TECHRPTS/2000/usccse2000-505/usccse2000-505.pdf

Focus Group Discussion Guide – 2004

Participants: University of Moratuwa 2nd year IT Students
Objectives : To determine to what extent their university education builds the 'soft' or generic skills required by industry including,

1. Teamwork skills – being a team player and being a team leader
2. Problem-solving skills – the ability to look at a problem, analyse it into its parts, decide what is already known and what needs to be researched, conduct the research and arrive at an answer.
3. Good communication skills – oral presentation skills, written reports, English language skills
4. Study skills as skills to be consciously and knowledgeably employed by an independent learner in control of their own learning process.

Introduction (Orientating participants to the focus group) : This focus group is part of the research being conducted by Deborah Wyburn (the Australian lady you've probably seen around the faculty from time to time under the supervision of Dr. Ajith Madurapperuma) into how Moratuwa IT Faculty can improve its curriculum and the way that it delivers its curriculum to you, the students. As you know the IT Faculty of Moratuwa is continually revising its curriculum, particularly in consultation with industry and it is always looking for ways to improve its teaching. Student feedback is a very important part of this but your comments will only be valuable if they are honest and open (even if sometimes you have to be critical). The results of this focus group will only be given to Mrs. Wyburn and she has been requested not not to use any of your names in reporting the findings of her research to the university to guarantee the confidentiality of your answers.

Questioning Route

1. What is your name? Are you a Colombo person? If not, where do you come from? You are all in your second year at the University of Moratuwa. What has been your favorite subject so far?
    a. Probe – what made it a good subject? (lecturer, easy, interesting, practical, did well in it, lots of assignments and small exam/ no assignments and 100% exam)
2. Now I want you to think about **how** your courses have been taught.
    a. Probe - What makes a good lecture? What makes a bad lecture?
    b. Probe – Do you ask questions of your lecturer in class / does he or she ask questions of you?
    c. Probe – Tell me about some of the things that lecturers have done that have helped you to understand and learn their subject.
    d. Probe – Do you have any suggestions for other helpful things that could be done?
3. Give me an example of assignments or projects that you have enjoyed doing or which you found useful.
    a. Probe – What made it enjoyable /useful?
    b. Probe – What sort of assignments do you usually get – short answer or problem solving?
        i. Short Answer – the type of assignment where an answer can be found directly in a textbook/ in a library book/ on the Internet/ from your lecture notes

    ii. Problem Solving - is something where you have to work out the answer for yourself but you can get information that helps solve the problem from those sources. (i.e. write code that does X but how you get to X is up to you OR a "what do you think…" essay type question where there is no 100% correct answer.
    iii. If you get a mixture of both types, what percentage would be short answer and what percentage would be problem solving?

4. If you have a problem doing an assignment who do you go to for help?
    a. Probe - friends or fellow students
    b. Probe – particular lecturer / lecturer for the subject
5. Tell me about how you study. If you have an exam coming up what do you do to prepare for it?
    a. *Note: There are some possible answers that you can probe for below. If they come up with anything other than "read the textbook and lecture notes" or "do past exam papers", ask them if anyone helped them devise these study techniques or if they just thought of them by themselves.*
        i. *Make summaries of the content in your own words?*
        ii. *Special ways of memorizing content?*
        iii. *Do past exam papers?*
        iv. *Make up your own exam questions and try to answer them?*
        v. *Study in a group and ask each other questions?*
        vi. *Just read the textbook and your notes.*
6. Have you had any experience of working in groups or teams?
    a. Probe - Which subject?
    b. Probe - What was the assignment?
    c. Tell me about some of the difficulties you faced working in a team/group.
        i. Probe - What did your team do about the problem?
    d. What did you like most about group/team work?
    e. How did you conduct team meetings?
        i. Probe – Formal agenda and meeting minutes or an informal get-together?
        ii. Probe – Did everyone contribute or did one or two people dominate?
    f. How did you decide who was going to do what on an assignment?
    g. What do you think makes a good team leader?
        i. Without mentioning names, were your team leaders good team leaders? Why or why not?
7. I'd like you to draw me a pie chart which shows how important you think the following skills are to success at university?
    a. Ability to rote learn or memorize content
    b. Ability to solve problems (understand concepts and apply them)
    c. Good written communication skills
    d. Good oral communication skills
    e. Good English
    f. Being able to work well in a team
    g. Knowing how to study effectively
8. Describe the IT graduate that every employer is going to want to employ.
    a. Probe - Now draw the pie chart again but this time show how important you think each of these skills might be to a potential employer.

Summing Up : Finally, based on everything we've talked about, what sort of things do you think the university can do to best help you become that ideal, very employable graduate? So you think lecturers can be more…../less …..; can do more of …../ less of ….. That the university can provide ………..

Focus Group Discussion Guide – 2005

Participants: University of Moratuwa 2nd year IT Students
Objectives : To determine to what extent their university education builds the 'soft' or generic skills required by industry including,

1. Teamwork skills – being a team player and being a team leader
2. Problem-solving skills – the ability to look at a problem, analyse it into its parts, decide what is already known and what needs to be researched, conduct the research and arrive at an answer.
3. Good communication skills – oral presentation skills, written reports, English language skills
4. Study skills as skills to be consciously and knowledgeably employed by an independent learner in control of their own learning process.

Introduction (Orientating participants to the focus group) : This focus group is part of the research being conducted by Deborah Wyburn (the Australian lady you've probably seen around the faculty from time to time under the supervision of Dr. Ajith Madurapperuma) into how Moratuwa IT Faculty can improve its curriculum and the way that it delivers its curriculum to you, the students. As you know the IT Faculty of Moratuwa is continually revising its curriculum, particularly in consultation with industry and it is always looking for ways to improve its teaching. Student feedback is a very important part of this but your comments will only be valuable if they are honest and open (even if sometimes you have to be critical). The results of this focus group will only be given to Mrs. Wyburn and she has been requested not not to use any of your names in reporting the findings of her research to the university to guarantee the confidentiality of your answers.

Questioning Route

1. Where did you go to High School? Was IT your first choice? What experience did you have with IT at school?
2. What do you think you will like about working in the IT field, what do think you will not like? What sort of person do you think makes a good IT person (what sorts of skills do they need)?
3. You are all in your second year at the University of Moratuwa. What has been your favorite subject so far?
    a. Probe – what made it a good subject? (lecturer, easy, interesting, practical, did well in it, lots of assignments and small exam/ no assignments and 100% exam)
4. Now I want you to think about **how** your courses have been taught.
    a. Probe - What makes a good lecture? What makes a bad lecture?
    b. Probe – Do you ask questions of your lecturer in class / does he or she ask questions of you?
    c. Probe – Tell me about some of the things that lecturers have done that have helped you to understand and learn their subject.
    d. Probe – Do you have any suggestions for other helpful things that could be done?
5. Give me an example of assignments or projects that you have enjoyed doing or which you found useful.
    a. Probe – What made it enjoyable /useful?
    b. Probe – What sort of assignments do you usually get – short answer or problem solving?

        i. Short Answer – the type of assignment where an answer can be found directly in a textbook/ in a library book/ on the Internet/ from your lecture notes
        ii. Problem Solving - is something where you have to work out the answer for yourself but you can get information that helps solve the problem from those sources. (i.e. write code that does X but how you get to X is up to you OR a "what do you think…" essay type question where there is no 100% correct answer.
        iii. If you get a mixture of both types, what percentage would be short answer and what percentage would be problem solving?

6. In the Software Engineering course you've just finished, all your assignments, readings, lectures etc were on a course management system called Moodle.
    a. Was this useful? How? What were the disadvantages of this approach?
    b. All of the lectures notes on Moodle had the recorded lecture attached in your lecturer's voice. Was this useful/not useful? How was it useful? Did it help to be able to listen to the lecture in English at your own pace or not?
    c. Is there a better way that lecturers can make the lecture notes available to you? Would giving everything to you on a CD at the beginning of the course be helpful?
    d. Were the quizzes useful? Did you do them when you were studying for the exam or during the semester?
    e. Your lecturers are interested in making Moodle more useful for you. What do you think of these ideas for additions to the Moodle page for Software Engineering.
        i. A FAQ page to cover questions that students often ask?
        ii. A list of difficult words in English with definitions in Sinhala and Tamil.
7. People in the focus groups last year said that they thought that 3 hour lectures were too long. Do you agree with them or not? How long do you think a lecture should be?
    a. Your lecturer used a different approach in lectures for this course; she asked you to sit in your teams and ask questions based on the lectures pre-recorded in Moodle.
        i. What was good/bad about this approach?
        ii. By using this approach your lecturer was trying to give you a chance to ask questions about things you didn't understand. A lot of your lecturers have said that it is difficult to know what you do understand and what you don't understand because very few people ask questions or answer questions in class. How do you think lecturers could go about getting people to interact more in class?
8. In the survey forms you filled in at the end of last semester, some of you said that you thought the course was too heavy? We're interested to know what you meant by that? Was there enough time to cover the course content? Were there too many PBL activities ? Were there too many assignments or were the assignments too difficult?
9. Tell me about how you study. If you have an exam coming up what do you do to prepare for it?
    a. *Note: There are some possible answers that you can probe for below. If they come up with anything other than "read the textbook and lecture notes" or "do past exam papers", ask them if anyone*

helped them devise these study techniques or if they just thought of them by themselves.

   i. *Make summaries of the content in your own words?*
   ii. *Special ways of memorizing content?*
   iii. *Do past exam papers?*
   iv. *Make up your own exam questions and try to answer them?*
   v. *Study in a group and ask each other questions?*
   vi. *Just read the textbook and your notes.*

10. Have you had any experience of working in groups or teams?

   a. Probe - Which subject?
   b. Probe - What was the assignment?
   c. Tell me about some of the difficulties you faced working in a team/group.
      i. Probe - What did your team do about the problem?
   d. What did you like most about group/team work?
   e. How did you conduct team meetings?
      i. Probe – Formal agenda and meeting minutes or an informal get-together?
      ii. Probe – Did everyone contribute or did one or two people dominate?
   f. How did you decide who was going to do what on an assignment?
   g. What do you think makes a good team leader?
      i. Without mentioning names, were your team leaders good team leaders? Why or why not?

11. People in the previous focus group said that *Kuppi* were a good way to learn difficult material. Did any of you participate in a Kuppi last semester? What topics did they cover? Who ran the *Kuppi* – a senior student?, someone from your batch?
12. What do you think is the main reason for using a PBL approach in teaching Software Engineering?
   a. A major difference in using a PBL approach is the emphasis on teams. Did any of the PBL sessions you did help you in working with your own team? (Sessions: What is a team? Code of Ethics, How to run a meeting, Conflict resolution).
   b. You have 3 different team leaders in this course. Think about which one was the best team leader and tell us what made him/her such a good team leader. What sorts of things should team leaders avoid doing?
   c. Students from other courses have told us that it is difficult for them to get their fellow team members to come to a team meeting. Did having the lecturers fix the time of the team meetings make that easier? How did having the lecturers at meetings help you? What could they have done better? Is it better for lecturers to attend your team meetings or have them by yourself?
   d. How did you approach doing the last assignment in your team? How did you decide how to go about answering the assignment? How did you decide who was going to do what?
   e. How often did you meet as a team? What did you do in those team meetings? Did you keep minutes, have an agenda etc. Did you feel free to say whatever you wanted in team meetings even if you thought the others might disagree with you? Who was responsible for putting the final assignment together? Did you have any problems with your work and did the other members of your team help you with it?

f. Did you have ongoing conflicts in your team or were you able to resolve them quickly? Did your team members/team leader let you know when you'd done a good job? Did your team celebrate when you'd done well in an assignment?
g. In some cases, people complained all through the semester that some members of their team were not contributing much at all. But when the peer assessment forms were handed in, this didn't show up. Why not? Can you suggest any other fair way to decide who gets what mark or do you think that all members of the team should get the team mark?
h. This semester you will have to work in teams as well. What will you try to do better next time? What do you think you did well this time?
i. What language did you usually use at team meetings?

13. The previous batch of students who did Software Engineering without PBL said that the course didn't help them to understand how software engineering was done in real life. As the result of this your lecturer changed the assignments. Do you think the assignments you did helped you understand better what real-life software engineers do? Is there anything else that can be done in the course to give you a better understanding of software engineering in the real world?
14. The average satisfaction rating for the course from the survey form you filled in last year was pretty low – so obviously there are a few things that we aren't doing right. Overall what is your summary of the good things about the Software Engineering course, and the things that could be improved and do you have any suggestions about how we could improve them?

Focus Group Discussion Guide – 2006

1. INTRODUCTION

- Introduce Self and ACN
- Explain market research and not having right or wrong answers when expressing feelings or attitudes
- Explain the recorder and confidentiality

2. WARM UP

Today we are going to talk about your study courses, projects and your learning and teaching techniques.

a) Before we start, could you please introduce yourself…can I know your name, age…where are you from…

b) Where did you go to school …what did you study in school for A/L's? Did you follow any courses after your A/Ls…..if yes what were they…. How about computing, did you study computing in school/ follow a course etc……

c) Now all of you are in your second year at the University of Moratuwa. Tell me what are the courses that you follow now…why did you select that field?

d) You mentioned IT, tell me was IT your first choice when applying for the university… Why?

e) What do you like/ dislike about working in the IT field…Why?

f) According to you what are the skills which make a good IT person…why?

g) According to you what are the skills that you need when you apply for a job in the IT industry…why?

3. TEACHING TECHNIQUES

a) Now I want you to think about how your courses have been taught…..What you think of your Software Engineering lectures in general…

- Interesting/ boring
- Theoretical
- Long hours … why?

b) According to you what are the things that makes a good lecture...why?

c) What makes a bad lecture....why?
(Moderator to probe)

4. MOODLE

a) What is your opinion of the course management system 'MOODLE' that you have used during the Software Engineering course?

I. What are the advantages…why?
   - Lecture in audio
   - Quizzes to review
   - Easy accessibility

II. Disadvantages of it? … Why?
   - Needs too many computer facilities
   - More time consuming

   (Moderator to probe on I and II)

III. In which way do you think this method can be improved? … Why?
   - Making course notes available
   - Making the entire course available on a CD
   - By providing a FAQ page to cover questions that students often ask
   - By providing a list of difficult words in English with definitions in Sinhala and Tamil
   - Provide the information in a simpler language

   (Moderator to probe)

IV. Does it helps to listen to lectures in English at your own pace/ not……why?

V. Were the quizzes useful?.... was it helpful to make up your own quizzes? …did you do any of the quizzes that were made up by other teams? ….did you do them when studying for the exams OR as you went along during the semester?

5. QUESTION AND ANSWER

a) This time your lecturer used a different approach…she asked you to make up and answer questions about slides… what is your opinion on this?

b) Why did she do this?...Did it help you to remember / understand the lecture any better…How?

c) What are the positives/ negative of this method…why?

d) How can this technique be improved…can you explain it further?

6. STUDY TECHNIQUE

a) How do you usually remember things when studying for exams? Do you study in a group or by yourself…why?

b) You mentioned that you are studying in a group…how does it happen…can you explain it to me…who else is there in the group…why?
   - Senior students tutoring
   - Student in the batch tutoring
   - Making up questions for each other
   - Just being together to stay awake

c) You said that you are studying alone also…how do you study…why?
   - Make notes
   - Underline things in the books
   - Just read the book

d) Lets talk about *Kuppi*…..People in the previous focus group said that a *Kuppi* was a good way to learn difficult material. Do you agree?

   I. Did any of you participate in a *Kuppi* last semester?...why?... What topics did they cover?

   II. Who conducted the *Kuppi*
      - a senior student
      - Someone from your batch

7. ASSIGNMENTS/ PROJECTS

a) What sort of assignments do you get in this course…are they good preparation for your future as an IT professional…what is your opinion on it…

b) Do you like/ dislike getting real life assignments…why?

c) I would like to discuss your assignments in detail…you said that there was an assignment where you had to design a spare parts ordering system for CarMart. How did you approach that assignment?
(Moderator to understand whether they worked as a team or individually)

d) What are the positives/ negative of that assignment and the approach…why?

e) What do you think about the ICT design project subject…how did you approach doing the work for deliverables…why?
(Moderator to understand whether they worked as a team or individually and to understand the approach in detail)

f) What are the positives/ negative of this subject and the approach…why?

g) You watched a video where the groups of Singaporean students working through a problem solving process. What do you think about it?

h) Did you use that method for your assignment…How? Did it help in producing a better assignment…How?

i) Do you think that your presentation skills improved as a result of doing this course…why?

j) If you are given the chance to propose assignments what sort of assignments would you like to do…why?

8. TEAM WORK

a) I understood that most of your assignments are done in groups. Based on your past experience can you tell me…

   I. What are the qualities that make a good team leader…why? What should team leaders avoid doing…why?

   II. How does a team function? Can you describe a team meeting to me?
      - Code of ethics
      - Agenda
      - Minutes of the meeting
      - Time/ frequency of meeting
      - Language used
      - Conflict resolution
      - Allocation of work load
      - Mutual support of team members

   III. Who is responsible for the final assignment…Why?

   IV. Do you celebrate when you have done well in the assignments…if so how?...if not why?

   V. What makes the difference between having a successful team and having a team that doesn't pull together… where does your group stand/ in which category does your teams fall in?... tell me the exact moment that you felt that you are working in team?

b) How do you get marks for team assignments? What are the advantages/ disadvantages of it…?... Why?
   (Moderator to probe)

c) Do you have any suggestions on how to give marks for a team assignment?... Why?

d) What are the things that you can improve as a team in your next assignment?
   (Moderator to probe)

9. COURSE CONTENT

a) What do you think about the content of the course ... why?
   - Too heavy
   - Not enough time to cover the course content
   - Too many PBL activities
   - Too many assignments
   - Assignments were too difficult

   (Moderator to probe)

b) Finally tell me what is actually good / bad about the Software Engineering course?...The ICT Design Project course? why?

c) What are the things that can be done to improve these courses?
   (Moderator to probe)

THANK YOU

Focus Group Discussion Guide - 2007

1. INTRODUCTION

- Introduce Self and ACN
- Explain market research and not having right or wrong answers when expressing feelings or attitudes
- Explain the recorder and confidentiality

2. WARM UP

Today we are going to talk about your courses, particularly software engineering, your projects, how you go about learning and how your lecturers go about teaching.

a) Before we start, could you please introduce yourself…can I know your name, age…where are you from…

c) Where did you go to school …what did you study in school for A/L's? Did you get taught in English, Sinhala or Tamil at school?

h) Now all of you are in your second year at the University of Moratuwa. Tell me why did you decide to do IT?

i) Was IT your first choice when applying for the university… Why?

j) According to you, what are the skills which make a good IT person…why?

k) According to you, what are the skills that you need when you apply for a job in IT industry…why?

9. TEACHING TECHNIQUES

d) Now I want you to think about how your courses have been taught…..What do you think of your Software Engineering **lectures** in general…

- Interesting/ boring
- Easy to follow / difficult to understand
- Theoretical
- Long hours … why?

e) According to you what are the things that make a good lecture...why?

f) What about the industry videos you saw in lectures? Were they interesting / useful?....why?

g) What makes a bad lecture....why?
(Moderator to probe)

MOODLE

h) What is your opinion of the course management system 'MOODLE' that you have used during the Software Engineering course?

IV. What are the most useful parts of it….what did you like most about it…why?
- Lecture notes online and also with audio recorded
- 'Lessons' that cover all content – no need to read text book
- Quizzes to review
- Glossary
- Easy accessibility – everything in one place.

V. Were there any problems in using it? … Why?
- Insufficient computer facilities
- More time consuming
- Not enough access to the lab
- Don't like reading online – prefer hardcopy

(Moderator to probe on I and II)

VI. In what way do you think the Moodle could be improved? … Why?
- Provide hardcopy of the lessons
- Provide the lessons on CD so that you could take it home

(Moderator to probe)

VI. Does it help to listen to lectures in English at your own pace (like on the Moodle)/ not……why?

VII. Were the quizzes useful? ….did you do them when studying for the exams OR as you went along during the semester?

VIII. Was it useful to have the content on the Moodle as lessons (with quiz questions after each page) or would it be better to stick to the textbook and lecture notes? …..Were the lessons difficult to understand ? ….language too complicated…..questions at the end of each page / section too difficult? ….

IX. Does the glossary need to be improved? ….how?...more technical words defined…non-technical words…….definitions in Sinhala and Tamil.

X. Is there anything more that the course organizers could do to help you polish up your English and learn the jargon of software engineering?

XI. What did you think of using a Wiki to do your assignment on?

5. STUDY PATTERNS

a) How do you usually remember things when studying for exams? Is it in a group or do you study by yourself…why?

b) You mentioned that you are studying in a group…how does it happen…can you explain it to me…who else is there in the group…why?
- Senior students tutoring
- Student in the batch tutoring

- Making up question for each other
- Just being together to stay awake

e) You said that you are studying alone also…how do you study…why?
   - Make notes
   - Underline things in the books
   - Just read the book

f) Lets talk about *Kuppi*…..People in the previous focus group said that a *Kuppi* was a good way to learn difficult material. Do you agree?

   III. Did any of you participate in a *Kuppi* last semester?...why?... What topics did they cover?

   IV. Who conducted the *Kuppi*
      - a senior student
      - Someone from your batch

6. ASSIGNMENTS

k) What sort of assignments do you get in this course…are they good preparation for your future as an IT professional…what is your opinion on it…

l) Do you like/ dislike getting real life assignments…why?

m) I would like to discuss about your assignments in detail…you said that in your assignment you had to design a spare parts ordering system for CarMart. How did you approach that assignment?
(Moderator to understand whether they worked as a team or individually)

n) What are the positives/ negative of that assignment and the approach…why?

o) Was it helpful to go through the SRS (Software Requirement Specification) template with the Academy of Design example before you started your CarMart assignment?

p) Was it useful to be able to watch the video of your team members asking questions of Mr Amerasinghe (the client)?

q) Your lecturers tell us that most of you didn't use the discussion forum to ask Mr Amerasinghe questions about the assignment. Why not?....worried about English….no need because all questions answered in video…didn't know about it.

r) Can you think of any other way in which the assignment can be improved to make it easier?…..to make it a better experience of real life software engineering?

7. PROBLEM SOLVING

a) You all watched a video where the groups of Singaporean students working through a problem solving process. What do you think about it?

b) Did you use that method for your assignment…How?

c) Do you think you will be able to use the same approach for solving other problems such as in your Project or Independent Study units?

8. TEAM WORK

b) I understood that most of your assignments are done in groups. Based on your past experience can you tell me…

VI. What are the qualities that make a good team leader…why? What should team leaders avoid doing…why?

VII. How does a team function? Can you describe a team meeting to me?
- Time/ frequency of meeting
- Language used
- Conflict resolution
- Discuss, work together or just allocate and do?
- Allocation of work load…..who allocates?...who gets what?
- Mutual support of team members

VIII. Did you learn much from your fellow team members while you were working on the assignment?

IX. What makes the difference between having a successful team and having a team that doesn't pull together… where does your group stand/ in which category does your teams fall in?... tell me the exact moment that you felt that you are working in team?

X. Did everyone in the team get involved in the team assignment? Why or why not?

XI. Did you choose your team or were you assigned to a team by the lecturers? Does this make a difference to the way you work?...How?....More discussion….working more together and less individually.

e) You did an exercise in your tutorial sessions to find out what sort of Myers-Brigg type you and your team mates were (ISTJ or ENFP etc). Was this helpful for understanding your team mates? …couldn't understand it …why did we do it?

f) How do you get marks for team assignments? What are the advantages/ disadvantages of it…?... Why?
(Moderator to probe)

g) Do you have any suggestions on how to give marks for a team assignment?... Why?

h) What are the things that you can improve as a team in your next assignment?
(Moderator to probe)

9. COURSE CONTENT

d) What do you think about the content of the course ... why?
   - Too heavy
   - Not enough time to cover the course content
   - Not enough time to do the assignment
   - Assignment was too difficult

   (Moderator to probe)

e) Finally tell me what is actually good / bad about the Software Engineering course?... why? …how does it compare to your other courses?

f) What are the things that can be done to improve these courses?
   (Moderator to probe)

THANK YOU

STUDENT COURSE EXPERIENCE QUESTIONNAIRE 2004 / 2005

Your cooperation in completing this questionnaire is greatly appreciated. It is very important that you consider each answer carefully as your answers will help to improve the course for future students. You are not required to put your name on this questionnaire and your answers will remain confidential. Only aggregate results will be reported.

Please put a cross in the square that most accurately reflects the extent to which you agree or disagree with the statement
SD-Strongly Disagree, **D**=Disagree, **N**=Neutral, **A**=Agree and **SA**=Strongly Agree

---

	SD	***D***	***N***	***A***	***SA***
1. The subject was interesting and made me think.					
2. The workload was too heavy.					
3. Doing this subject helped me to develop my ability to work as a team member.					
4. I always knew exactly what the lecturer wanted me to do.					
5. Using Information Technology helped me with the subject.					
6. The lecturer normally gave me helpful feedback on my work (oral and/or written).					
7. Doing this subject has improved my problem-solving skills.					
8. Doing this subject has made me interested in further learning.					
9. It was always easy to know the standard of work expected.					
10. In this subject, I was tested more on what I had memorized than what I had understood.					
11. Doing this subject provided me with a good opportunity to develop skills in using computing applications that I will be able to use at work.					

12. The lecturer tried hard to understand difficulties I might be having with my work.					
13. During my studies, it has been useful for me to be in contact with lecturers who are doing research as well as teaching.					
14. The lecturer for this subject was very good at explaining things.					
15. Because there is so much work in this subject, it is difficult to understand it all.					
16. I often made comments and asked questions in lectures.					
17. My spoken communication skills are better as the result of doing this subject.					
18. To do well in this subject, all you really need is a good memory.					
19. Doing this subject has improved my skills in written communication.					
20. There are not enough library / Internet resources available to do the set assignments well.					
21. Doing this subject has improved my skills in using the library/Internet resources available.					
22. The only feedback I got while doing this subject were my grades.					
23. Doing this subject has helped me to develop my ability to plan my own work.					
24. I am confident that I could learn a computer package on my own (not going to a formal course).					
25. After doing this subject, I feel that I understand how software engineering is used in the IT industry.					
26. I am happy to talk about my ideas with other people.					
27. I sometimes felt that my time in class was being wasted.					
28. Students ideas and suggestions are always considered in this subject.					
29. I feel that I belong to a group of students and staff committed to learning.					
30. Overall I was satisfied with the quality of this course.					

31. What did you like best about the way this subject was taught? Say why.

32. What should be improved about how this subject is taught? Say why.

33. What was the most useful activity you did while doing this subject (for instance, attending lectures / doing the assignments / doing the group work assignments / giving presentations / anything else)?

34. What sort of work will you be looking for when you graduate?

STUDENT COURSE EXPERIENCE QUESTIONNAIRE - 2006

Your cooperation in completing this questionnaire is greatly appreciated. It is very important that you consider each answer carefully as your answers will help to improve the course for future students. You are not required to put your name on this questionnaire and your answers will remain confidential. Only aggregate results will be reported. Because you had 2 lecturers for the course, in questions related to the lecturer where the answer is different depending on which lecturer you are thinking about, you can mark 2 boxes.

Please put a cross in the square that most accurately reflects the extent to which you agree or disagree with the statement
SD-Strongly Disagree, **D**=Disagree, **N**=Neutral, **A**=Agree and **SA**=Strongly Agree

---

	SD	***D***	***N***	***A***	***SA***
1. The subject was interesting and made me think.					
2. The workload was too heavy.					
3. Doing this subject helped me to develop my ability to work as a team member.					
4. I always knew exactly what the lecturer wanted me to do.					
5. Using Moodle helped me with the subject.					
6. The lecturer normally gave me helpful feedback on my work (oral and/or written).					
7. Doing this subject has improved my problem-solving skills.					
8. Doing this subject has made me interested in further learning.					
9. It was always easy to know the standard of work expected.					
10. In this subject, I was tested more on what I had memorized than what I had understood.					
11. Doing this subject provided me with a good opportunity to develop skills in using computing applications that I will be able to use at work.					

12. The lecturer tried hard to understand difficulties I might be having with my work.
13. During my studies, it has been useful for me to be in contact with lecturers who are doing research as well as teaching.
14. The lecturer for this subject was very good at explaining things.
15. Because there is so much work in this subject, it is difficult to understand it all.
16. I often made comments and asked questions in lectures.
17. My spoken communication skills are better as the result of doing this subject.
18. To do well in this subject, all you really need is a good memory.
19. Doing this subject has improved my skills in written communication.
20. There are not enough resources available to do the set assignments well.
21. As the result of working as a team, I now know how a good team leader should act.
22. The only feedback I got while doing this subject were my grades.
23. Doing this subject has helped me to develop my ability to plan my own work.
24. I am confident that I could learn a computer package on my own (not going to a formal course).
25. After doing this subject, I feel that I understand how software engineering is used in the IT industry.
26. I am happy to talk about my ideas with other people.
27. I sometimes felt that my time in class was being wasted.
28. Student's ideas and suggestions are always considered in this subject.
29. I feel that I belong to a group of students and staff committed to learning.
30. Overall I was satisfied with the quality of this course.

31. Describe any training in using computers that you received before starting your studies at Moratuwa Faculty of Information Technology.

32. Was Information Technology your first preference when you applied for university? If not, what was?

33. What sort of work will you be looking for when you graduate? Why?

34. What did you like best about the way this subject was taught? Say why.

35. What should be improved about how this subject is taught? Say why.

36. In any course, there are many ways to learn. What we would like to know is **how** much each of the learning activities you experienced in the Software Engineering course **helped you to learn the subject**. Write numbers in the boxes below to put the following activities in order of their usefulness - from '1' for the **most useful** to '10' for the **least useful**. Please note that marking an activity as '10' does not necessarily mean that you thought the activity was a waste of time, only that it was less useful than other activities. **If you didn't do some of the activities, leave their boxes blank**.

- ☐ Self-study
- ☐ Doing the tutorials on Moodle
- ☐ Listening to the recorded lectures on Moodle
- ☐ Doing the quizzes on Moodle
- ☐ Creating quizzes for others.
- ☐ Asking questions to other teams in lecture times.
- ☐ Attending lectures
- ☐ Working with your team
- ☐ Participating in *Kuppis*
- ☐ Doing the assignments

37. Which of the tutorials on Moodle was the most useful for you. Explain why?

- ☐ Week 1 – Video interviews with local industry leaders, chapter on team skills, TESCO advertisement.
- ☐ Week 3 & 4 – Case Study : Building Apache Server
- ☐ Week 5 – Creating multiple choice quizzes for chapters from textbook
- ☐ Week 7 & 8 – Watching the students in Singapore go through the problem solving process and applying the process to Assignment 2
- ☐ Week 9 – Opportunity to ask questions of Mr. Ajith Samaranayake of Millenium IT
- ☐ Week 10 – Listening to public speaking video and producing checklist
- ☐ Week 11 – Using checklists to assess presentations of fellow students

STUDENT COURSE EXPERIENCE QUESTIONNAIRE

Your cooperation in completing this questionnaire is greatly appreciated. It is very important that you consider each answer carefully as your answers will help to improve the course for future students. You are not required to put your name on this questionnaire and your answers will remain confidential.

Background Information

1. What sort of school did you do your A/Ls at?			Girls only school	☐	Boys only school	☐	Mixed school	☐
2. Which language did you study in at A/L?			Sinhala	☐	Tamil	☐	English	☐
3. Did you study computing at A/L or O/L?			Yes at A/L	☐	Yes at O/L	☐	No	☐
4. Did you do a computing course after school?			Yes	☐	No	☐		
5. What was your first preference of university course?	IT	☐	Engineering	☐	Medicine	☐	Other	☐

Please put a cross in the square that most accurately reflects the extent to which you agree or disagree with the statement
SD-Strongly Disagree, **D**=Disagree, **N**=Neutral, **A**=Agree and **SA**=Strongly Agree

---

	SD	***D***	***N***	***A***	***SA***
1. The subject was interesting and made me think.					
2. The workload was too heavy.					
3. Doing this subject helped me to develop my ability to work as a team member.					
4. I always knew exactly what the lecturer wanted me to do in assignments.					
5. It was helpful to have everything on Moodle.					
6. It would have been better to have been given the Moodle materials on a CD.					
7. Doing this subject has improved my problem-solving skills.					

8. Doing this subject has made me interested in further learning.					
9. I sometimes felt that my time in class was being wasted					
10. The Glossary on the Moodle was very useful to me.					
11. The lecturer normally gave me helpful feedback on my work (oral and/or written).					
12. The lecturer tried hard to understand difficulties I might be having with my work.					
13. The lecturer was very good at explaining things in tutorials.					
14. The lecturer was very good at explaining things in lectures.					
15. Because there is so much work in this subject, it is difficult to understand it all.					
16. I often made comments and asked questions in lectures.					
17. My spoken English communication skills are better as the result of doing this subject.					
18. To do well in this subject, all you really need is a good memory.					
19. Doing this subject has improved my skills in written communication.					
20. We should get individual marks for team assignments based on how much work we do.					
21. As the result of working as a team, I now know how a good team leader should act.					
22. Doing this course in English was difficult for me.					
23. After doing this subject, I feel that I understand how software engineering is used in the IT industry.					
24. I would prefer to do individual assignments rather than team assignments.					
25. Student's ideas and suggestions are always considered in this subject.					
26. Overall I was satisfied with the quality of this course.					

27. The IT employers we videoed emphasized English language skills. Is there any way that we could have helped you more in this course to develop English language skills suitable for Software Engineers?

28. The reason that you are asked to work in groups in so many ITFAC subjects, is because IT employers always emphasise the importance of teamwork skills. In terms of developing teamwork skills, do you think that it is better to be able to choose the people in your groups yourself or to work in groups assigned by lecturers. Why?

29. Does this course do enough to help you develop good teamwork skills? If not, what more do you think could be done?

30. What did you like best about the way this subject was taught? Say why.

31. What should be improved about how this subject is taught? Say why.

32. In any course, there are many ways to learn. What we would like to know is **how much** each of the learning activities you experienced in the Software Engineering course **helped you to learn the subject**. Write numbers in the boxes below to put the following activities in order of their usefulness - from ‘1’ for the **most useful** to ‘10’ for the **least useful**. Please note that marking an activity as ‘10’ does not necessarily mean that you thought the activity was a waste of time, only that it was less useful than other activities. **If you didn’t do some of the activities, leave their boxes blank**.

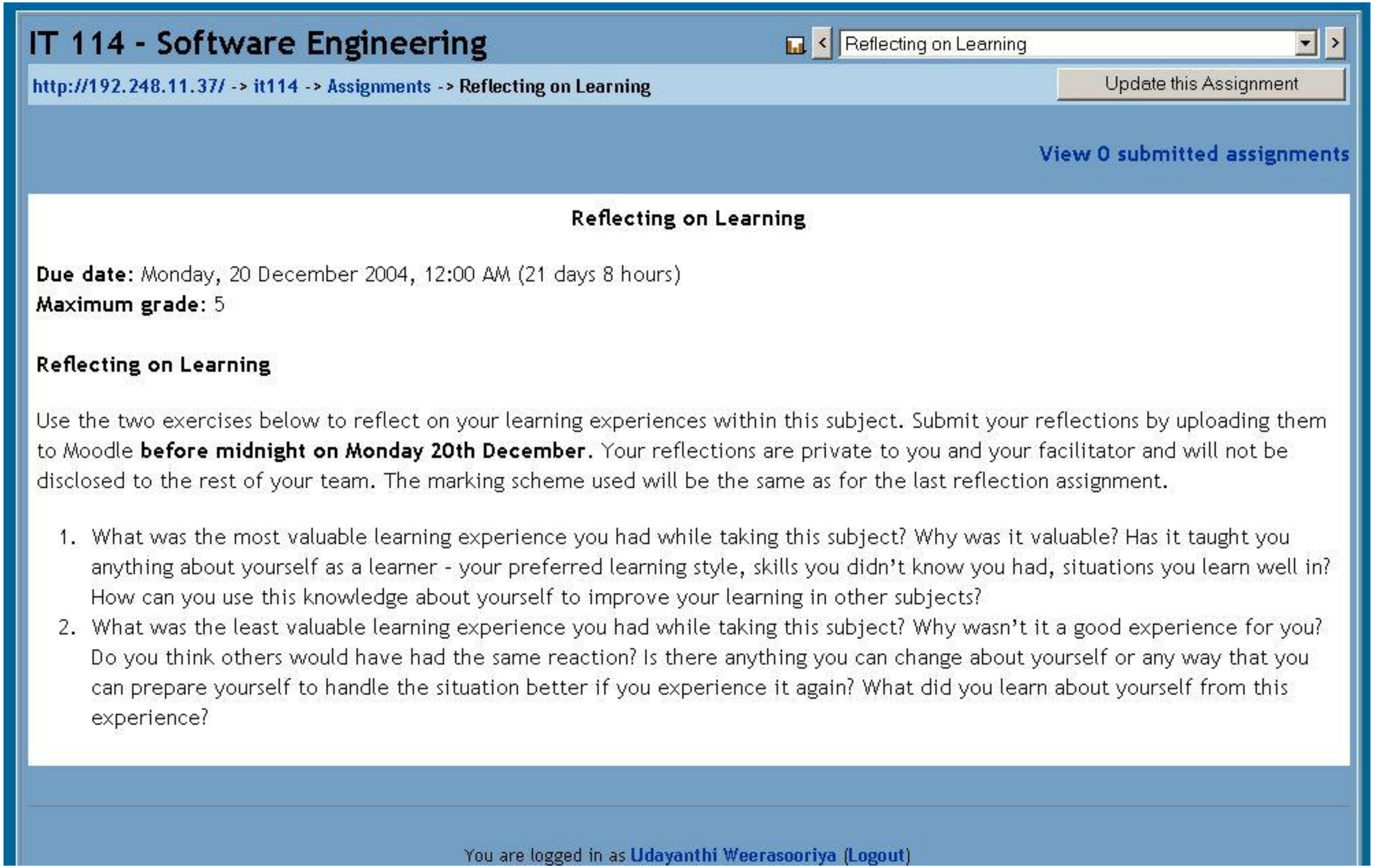
- ☐ Self-study.
- ☐ Doing the “lessons” on Moodle.
- ☐ Listening to the recorded lectures on Moodle.
- ☐ Doing the quizzes on Moodle.
- ☐ Listening to the industry videos about SE topics.
- ☐ Doing the assignment
- ☐ Attending lectures
- ☐ Working with your team
- ☐ Participating in *Kuppis*
- ☐ Going through the SRS template in tutorial sessions

33. Which of these resources provided to you during the course was useful for you? Again rate these from ‘1’ for the **most useful** to ‘10’ for the **least useful.** If you can’t remember using the resource, leave the box blank.

- ☐ Videos of local industry employers telling you what qualities they look for in new employees.
- ☐ Video of Singapore students explaining the problem solving process.
- ☐ Video of IT2104 students asking questions of Mr Amerasinghe.
- ☐ Discussion Forum where you could ask questions from Mr. Amerasinghe
- ☐ The Glossary in the Moodle.
- ☐ Flash animations of different types of CASE tools (in the lesson, Overview of Software Engineering).
- ☐ Reading the National IT Workforce Survey for information about IT jobs in Sri Lanka (in the lesson, Overview of Software Engineering)

Please comment :

Student Reflection Assignments 2005/2006



IT 114 - Software Engineering

Reflecting on Learning

http://192.248.11.37/ -> it114 -> Assignments -> Reflecting on Learning

Update this Assignment

View 0 submitted assignments

Reflecting on Learning

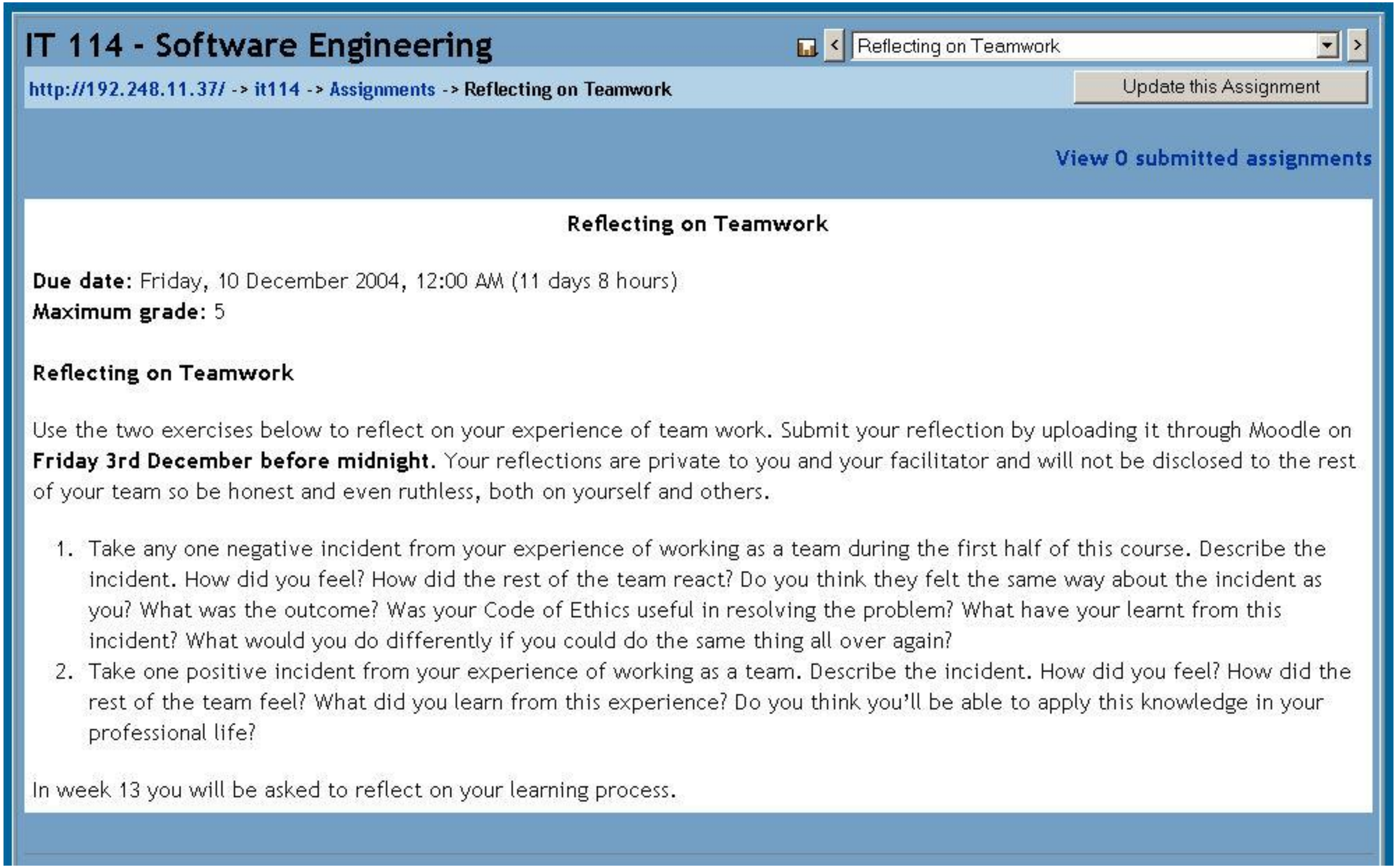
Due date: Monday, 20 December 2004, 12:00 AM (21 days 8 hours)
Maximum grade: 5

Reflecting on Learning

Use the two exercises below to reflect on your learning experiences within this subject. Submit your reflections by uploading them to Moodle **before midnight on Monday 20th December**. Your reflections are private to you and your facilitator and will not be disclosed to the rest of your team. The marking scheme used will be the same as for the last reflection assignment.

1. What was the most valuable learning experience you had while taking this subject? Why was it valuable? Has it taught you anything about yourself as a learner - your preferred learning style, skills you didn't know you had, situations you learn well in? How can you use this knowledge about yourself to improve your learning in other subjects?
2. What was the least valuable learning experience you had while taking this subject? Why wasn't it a good experience for you? Do you think others would have had the same reaction? Is there anything you can change about yourself or any way that you can prepare yourself to handle the situation better if you experience it again? What did you learn about yourself from this experience?

You are logged in as Udayanthi Weerasooriya (Logout)



IT 114 - Software Engineering

Reflecting on Teamwork

http://192.248.11.37/ -> it114 -> Assignments -> Reflecting on Teamwork

Update this Assignment

View 0 submitted assignments

Reflecting on Teamwork

Due date: Friday, 10 December 2004, 12:00 AM (11 days 8 hours)
Maximum grade: 5

Reflecting on Teamwork

Use the two exercises below to reflect on your experience of team work. Submit your reflection by uploading it through Moodle on **Friday 3rd December before midnight.** Your reflections are private to you and your facilitator and will not be disclosed to the rest of your team so be honest and even ruthless, both on yourself and others.

1. Take any one negative incident from your experience of working as a team during the first half of this course. Describe the incident. How did you feel? How did the rest of the team react? Do you think they felt the same way about the incident as you? What was the outcome? Was your Code of Ethics useful in resolving the problem? What have your learnt from this incident? What would you do differently if you could do the same thing all over again?
2. Take one positive incident from your experience of working as a team. Describe the incident. How did you feel? How did the rest of the team feel? What did you learn from this experience? Do you think you'll be able to apply this knowledge in your professional life?

In week 13 you will be asked to reflect on your learning process.

Appendix C

University of Moratuwa, Faculty of Information Technology

B.Sc. in Information Technology Curriculum

University of Moratuwa

Faculty of Information Technology

Faculty Board Paper: 034/001

Subject: Level 1 Curriculum and Syllabi
From: Dean, Faculty of Information Technology
Date:

Faculty Board approval is sought to submit the following Level 1 Curriculum and Syllabi of the course leading to B.Sc. in Information Technology at the Faculty of Information Technology, to the Senate to obtain necessary approval.

Level 1 Curriculum and Syllabi

Level 1			Lectures hrs/wk	Labs hrs/wk	Credits
IT 1001	Accountancy (Non GPA)	C	1	-	1
IT 1002	Communication Skill Development (Non GPA)	C	-	6	2
IT 1101	Object Oriented Programming	C	2	6	4
IT 1102	Web Technologies	C	2	3	3
IT 1103	Data Structures and Algorithms	C	2	3	3
IT 1201	Digital Circuits and Devices	C	2	3	3
IT 1202	Computer Organization	C	2	3/2	2.5
IT 1301	Data Communications and Computer Networking	C	2	3	3
IT 1501	Principles of Management	C	2	-	2
IT 1601	Multimedia Design	C	2	3	3
IT 1701	Mathematics for IT	C	2	3/2	2.5
IT 1702	Discrete Mathematics	C	2	3/2	2.5
IT 1801	Management Information Systems	C	2	-	2
IT 1901	Essentials of Information and Communication Technologies	C	2	3	3
IT 1999	Project on IT Applications	C	1	9/2	2.5
	Total (36 – GPA and 3 - Non-GPA)		25	39	39

Note:

i. *C = Compulsory
*E = Elective

ii. One Credit is equivalent to
1 hour of Lectures per week in a semester (13 weeks) or
3 hours of tutorials/laboratory classes per week in a semester

iii. Every level contains two semesters of 13 weeks each

University of Moratuwa

Faculty of Information Technology

Faculty Board Paper: 034/002

Subject: Level 2 Curriculum and Syllabi
From: Dean, Faculty of Information Technology
Date:

Faculty Board approval is sought to submit the following Level 2 Curriculum and Syllabi of the course leading to B.Sc. in Information Technology at the Faculty of Information Technology, to the Senate to obtain necessary approval.

Level 2 Curriculum and Syllabi

Level 2			Lectures hrs/wk	Labs hrs/wk	Credits
IT 2003	Business Studies (Non GPA)	C	1		1
IT 2004	Report & Proposal Writing (Non GPA)	C	1		1
IT 2104	Software Engineering	C	2	3	3
IT 2105	Object Oriented Analysis and Design	C	2	3	3
IT 2203	Operating Systems	C	2	3/2	2.5
IT 2204	Computer Architecture	C	2	3/2	2.5
IT 2302	Network Programming	C	2	3/2	2.5
IT 2303	Internetworking	C	2	3/2	2.5
IT 2304	Socket Programming	C	2	3	3
IT 2401	Logic Programming and Expert Systems	C	2	3	3
IT 2502	Social Aspects of IT	C	2	3/2	2.5
IT 2503	IT Project Management	C	2	3/2	2.5
IT 2602	Computer Graphics	C	2	3	3
IT 2703	Computational Mathematics	C	2	3/2	2.5
IT 2802	Data Management Systems	C	2	3	3
IT 2999	ICT Design Project	C		15/2	2.5
Total (38 – GPA and 2 - Non-GPA)			28	36	40

Note:

i. One Credit is equivalent to
  1 hour of Lectures per week in a semester (13 weeks) or
  3 hours of tutorials/laboratory classes per week in a semester

ii. *C = Compulsory
  *E = Elective

iii. Every level contains two semesters of 13 weeks each

University of Moratuwa

Faculty of Information Technology

Faculty Board Paper: 034/003

Subject: Level 3 Curriculum and Syllabi
From: Dean, Faculty of Information Technology
Date:

Faculty Board approval is sought to submit the following Level 3 Curriculum and Syllabi of the course leading to B.Sc. in Information Technology at the Faculty of Information Technology, to the Senate to obtain necessary approval.

Level 3 Curriculum and Syllabi

Level 3			Lectures hrs/wk	Labs hrs/wk	Credits
IT 3000	Industrial Training	C	-	18	6
IT 3104	Advanced Software Engineering	E	2	3	3
IT 3106	Internet Programming and Web Services	E	2	3	3
IT 3107	Automata Theory	E	2	-	2
IT 3108	Compiler Theory	E	2	3/2	2.5
IT 3205	Computer and Network Security	E	2	3/2	2.5
IT 3305	Design and Management of Networks	E	2	3/2	2.5
IT 3306	Information Systems Security	E	2	3/2	2.5
IT 3307	Wireless Communication and Networks	E	2	3/2	2.5
IT 3402	Neural Networks and Genetic Algorithms	E	2	3	3
IT 3403	Artificial Intelligence	E	2	3/2	2.5
IT 3504	Human Resource Management	E	2	-	2
IT 3505	Professional Practice	C	1	-	1
IT 3506	IT Quality Assurance	C	1	-	1
IT 3507	IT Enabled Marketing	E	2	-	2
IT 3603	Human Computer Interaction	E	2	3/2	2.5
IT 3604	Digital Image Processing	E	2	3/2	2.5
IT 3704	Statistics and Probability	E	2	3/2	2.5
IT 3802	Advanced Data Management Systems	E	2	3/2	2.5
IT 3803	e-Business Technologies	E	2	3	3
IT 3902	Independent Study	C	-	6	2
IT 3903	Bio Informatics I	E	2	3	3
IT 3999	Project	C	-	30	10
Total (66 – GPA)			38	84	66

FACULTY OF INFORMATION TECHNOLOGY

UNIVERSITY OF MORATUWA, SRI LANKA

Faculty Board Paper: 034/004

Subject: Level 4 Curriculum and Syllabi
From: Dean, Faculty of Information Technology
Date:

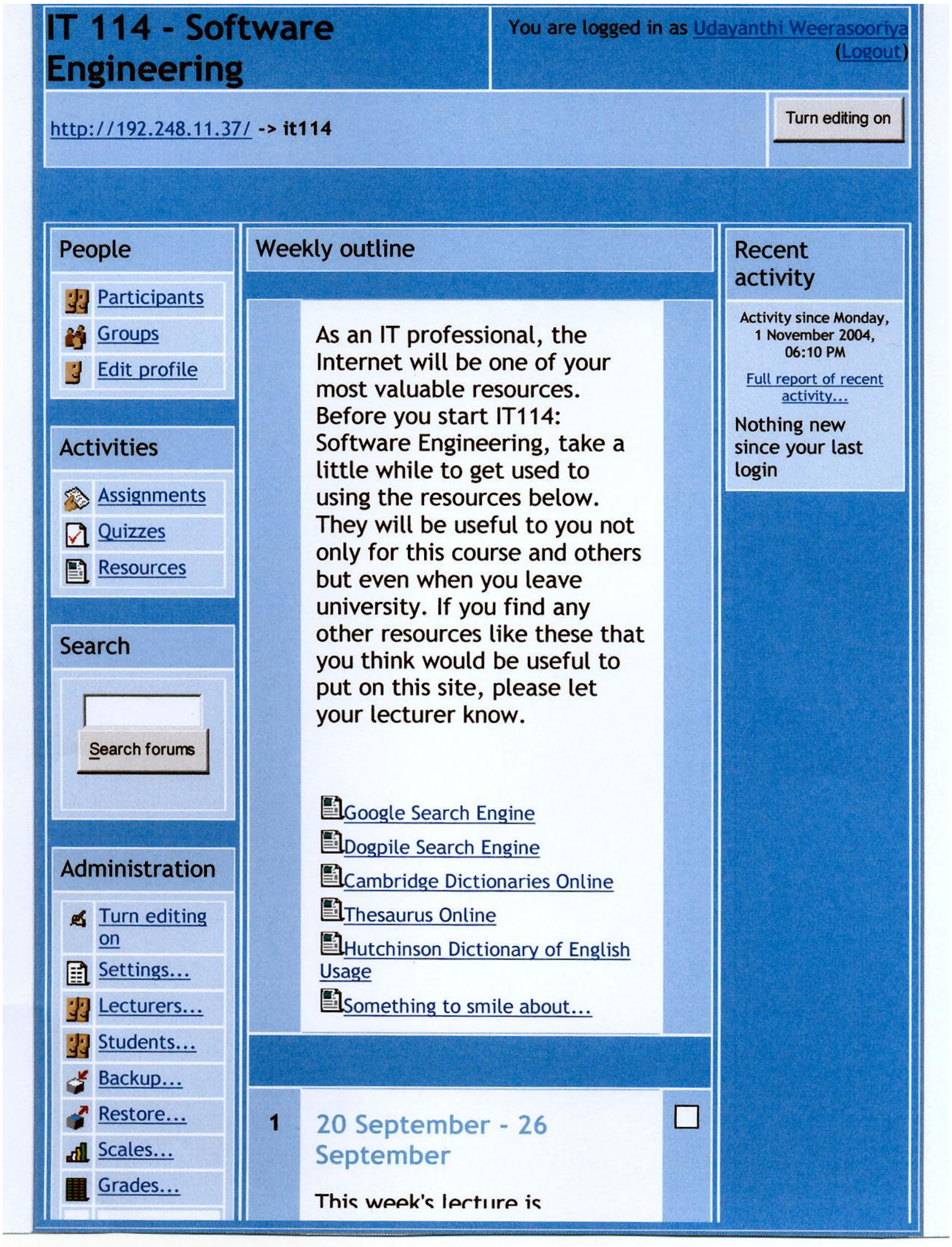
Faculty Board approval is sought to submit the following Level 04 Curriculum and Syllabi of the courses leading to B.Sc. in Information Technology (honours) at the Faculty of Information Technology, to the senate to obtain the necessary approval.

Level 4 Curriculum and Syllabi

Level 4			Lectures hrs/wk	Labs hrs/wk	Credits
IT 4005	Business Law (Non GPA)	C	1	-	1
IT 4109	Theory of Programming Languages	E	2	-	2
IT 4110	Distributed Processing	E	2	3/2	2.5
IT 4111	Concurrent Programming	E	2	3/2	2.5
IT 4113	Theory of Computability and Complexity	E	2	-	2
IT 4206	Embedded Systems	E	2	3/2	2.5
IT 4207	Parallel Processing	E	2	-	2
IT 4208	High Performance Computing	E	2	-	2
IT 4308	Mobile Computing	E	2	3/2	2.5
IT 4309	Broadband Networks	E	2	3/2	2.5
IT 4404	Natural Language Processing	E	2	3/2	2.5
IT 4405	Fuzzy Logic	E	1	-	1
IT 4406	Robotics	E	2	3/2	2.5
IT 4407	Agent Based Systems	E	2	3/2	2.5
IT 4503	Advanced IT Project Management	C	2	-	2
IT 4605	Computer Vision	E	2	3/2	2.5
IT 4804	Geographic Information Systems	E	2	3/2	2.5
IT 4805	Data Mining & Data Warehousing	E	2	3	3
IT 4903	Bio Informatics II	E	2	-	2
IT 4999	Individual Project	C	-	30	10
Total (51 – GPA 1 – Non GPA)			36	48	52

Appendix D

Moodle™ Interface – 2005


IT 114 - Software Engineering
You are logged in as Udayanthi Weerasooriya (Logout)
http://192.248.11.37/ -> it114
Turn editing on
People
Participants
Groups
Edit profile
Activities
Assignments
Quizzes
Resources
Search
Search forums
Administration
Turn editing on
Settings...
Lecturers...
Students...
Backup...
Restore...
Scales...
Grades...
Weekly outline
As an IT professional, the Internet will be one of your most valuable resources. Before you start IT114: Software Engineering, take a little while to get used to using the resources below. They will be useful to you not only for this course and others but even when you leave university. If you find any other resources like these that you think would be useful to put on this site, please let your lecturer know.
Google Search Engine
Dogpile Search Engine
Cambridge Dictionaries Online
Thesaurus Online
Hutchinson Dictionary of English Usage
Something to smile about...
1
20 September - 26 September
Recent activity
Activity since Monday, 1 November 2004, 06:10 PM
Full report of recent activity...
Nothing new since your last login

Logs...

Files...

Help...

Teacher forum

My courses

IT 114 - Software Engineering

All courses...

This week's lecture is "Introduction to Software Engineering". Listen to the lecture and do the quiz. For the rest of the course you are expected to listen to the lecture and do the quiz for that week **before** you come to the class. Your lecturer will expect you to have your questions ready.

In IT114:Software Engineering, you will be introduced to Problem Based Learning (PBL). What is PBL and why is it being used all over the world in the training of IT and other professionals? In your first tutorial session you will be asked to read "What is PBL?" to find out.

An important part of PBL is team work. Complete the assignment, "Why Teams?" before your team meeting next week.

And don't forget to do the "What sort of Team Player are you?" personality quiz **before cob next Monday.**

Introduction to Software

What's So New About Teams?

Project Management

Assessment

Something to smile about......

"What sort of a Team Player are you?" Personality Quiz

Introduction to Software Engineering PP Slides

2

27 September - 3 October

During this week, you will be placed into teams of five. These five people will be your team for the rest of the semester. All assignments for this course will be done as team assignments. Make sure you get to know your fellow team members very well as you will be depending on them and they on you.

The first assignment, "Team Web Sites & Member Profiles" will give you a good start on this. It is due at the beginning of Week 4.

There are also two readings that you MUST read before your team meeting next week. They are "Meetings: Time Wasters or Productivity Tool?" and "Running Meetings". You will be very busy this week. Don't waste time.

Software Process Models Lecture

Assignment 1: Team Web Site & Member Profiles

Quick HTML Reference

IT Faculty Team Web Page

Productivity Tool?

Assignment 1: Team Web Site & Member Profiles

Quick HTML Reference

IT Faculty Team Web Page

Something to smile about.....

Software Process Model ppt slides

3

4 October - 10 October

In this week's team meeting you will draw up your team's Code of Ethics. You may wish to read the chapter, 'Overcoming Team Discord' before you go to your tutorial this week. If you are not used to team work, you may not realise all the ways that a team can fall apart. In any case, you must read 'Overcoming Team Discord' for your tutorial next week on Conflict Resolution. Your task for this week is to add the Code of Ethics to your team web site before you submit it for assessment next week.

To help you draw up your Code of Ethics, your facilitator will talk to you about effective meeting procedures in this week's tutorial. The ability to run an effective meeting is essential to the success of your team this semester. If you can't run meetings well, you will find that you waste a lot of time and energy that would be far better spent on making your team the Software Engineering TEAM OF

THE YEAR.😊

Your Team Leader will also be nominated this week. Congratulations to these people and we wish you every success in what will be a challenging but rewarding job.

Software Project Management Lecture

Software Project Management Quiz

Overcoming Team Discord

Meetings Role Play

Code of Ethics

Something to smile about.....

Software Project Management ppt slides

4 11 October - 17 October

Your team web site should be submitted this week. We are really looking forward to seeing them. Don't forget to link them to individual member profiles.

Requirements Engineering Lecture

Requirements Engineering Quiz

Something to smile about .....

How to upload your web site stuff?

5 18 October - 24 October

Model

Case Study 1: A HIS for Asiri Hospital

Case Study 2: An online meter for CEB customers

Case Study 3: A Web Site for the School of Business Management

Case Study 4: An IS for the University of Moratuwa Accounts Dept.

Case Study 5: A Web Portal for UoM Projects

How do I Learn Best Quiz

Something to smile about .....

6

25 October - 31 October

By now you should be well into the work for your first big team assignment. There is a lot of reading isn't there. Not only in this course but in all your courses. You might be asking, "How am I expected to juggle all this work?". During this course and others in your university career, we hope that you will develop the ability to read efficiently and plan effectively as well as other study skills. Learning does not stop when you leave university and these skills will be skills for life. The in-class exercise for this week, "Improving your Study Skills" will give you a start on all this.

Your lecture topic is User Interface Design. Don't forget to try the Quiz!

User Interface Design Lecture

Something to smile about.....

Improving your Study Skills

Something to smile about.....

7

1 November - 7 November

Next week you will be expected to give your team presentation for Assignment Two. So this week your tutorial session will focus on Oral Presentation techniques.

This week's lecture topic is Verification and Validation.

Verification and Validation Lecture

Verification and Validation Quiz

Making Good Oral Presentations

Something to smile about.....

8

8 November - 14 November

Your lecture topic this week is Defect Testing. Remember that the reason your lecturer has taken so much time and trouble to record her lectures in advance and to create quizzes on the topic is so that you can use your lecture timeslots to clear up anything that you don't understand. Believe us, if you leave it until just before the exam to try to make sense of your notes, you'll only become more confused. Just ask the students who did SE last year.

Good luck with your presentations! There will be no tutorial activity this week as we will use the tutorial time slot for presentations.

Don't forget to email your *Peer Assessment Forms* to Ms. Weerasooriya at udayanthiw@itfac.mrt.ac.lk **by the end of this week** And don't forget to go out and celebrate with your team. Even if you had problems working together this time, you still have another chance to get it right with Assignment 3.

A big round of thanks for our departing team leaders and welcome to the new batch. Your team facilitators will let you know who your new team leaders are this week.

Defect Testing Lecture

Defect Testing Quiz

Peer Assessment Form - Assign 2

Something to smile about.....

9

15 November - 21 November

This week's lecture is on Software Metrics. As well as listening to lecturers, you'll be doing Part I of your major assignment this week. Part I must be submitted before **midnight next Wednesday**

24th November (what are weekends for anyway! 😊) That gives you just over one week!

For this assignment you'll be expected to apply what you've learnt in lectures to writing a formal Software Requirements Specification Document. For this you'll have to know how to get extra information from the Internet and how to write a formal report. To help you, we've made 'Internet Research' the topic of this week's tutorial and 'Writing Formal Reports' week 11's topic.

And once you've submitted Part I of your assignment on Wednesday...don't relax whatever you do.... 😊 .....read "What are Reflections?" for your tutorial on the Friday.

Software Metrics

Assignment 3: SRS Documentation - Part I

Internet Research

Something to smile about....

10 22 November - 28 November

This week's lecture topic is Software Cost Estimation.

Read the 'What are Reflections?' paper posted below. Your assignment is to reflect on how you have coped with the teamwork aspect of this course. Submit your 'Reflections on Teamwork' assignment by uploading it to Moodle on Friday next week (December 3rd). This exercise is compulsory but will be assessed on a good / satisfactory / unsatisfactory / not submitted basis only. The content is personal to you; if you are mature and honest in your reflections, they will help you to grow both as an IT professional and as a life-long learner. If you do the exercise just to pass the course, you will gain very little from it.

Software Cost Estimation Lecture

Software Cost Estimation Quiz

What are Reflections?

Reflecting on Teamwork

Assignment 3: SRS Documentation - Part II

Something to smile about....

11

29 November - 5 December

Time to hand in your reflections on team work and start another one. This time on learning. It is posted below as "Reflections on Learning". This is not due until the Monday after you finish this course (Monday 20/12)...so you have time to relax and **reflect** ......but keep it in the back of your mind.

The tutorial this week will focus on writing formal reports - SRS documents in particular. By the end of this week, you should have sorted out your report structure and everyone in your team should have been allocated a task to do. The difficult thing will be to put together what everyone writes and make it look and sound like it was written by one person, so make sure that you assign this important task to a very capable person.

This week's lecture is on Software Maintenance.

Software Maintenance Lecture

Software Maintenance Quiz

Reflecting on Learning

Formal Report Writing

Something to smile about....

12 **6 December - 12 December**

Next week you have to hand in your major assignment so we expect that you'll want to use most of this week's tutorial session in the lab to finish assignments. However we ask you to give us a little of your time first to fill out the Student Course Experience Questionnaire.

Moratuwa University has very close links with the IT Industry in Sri Lanka. They have told us that they need graduates who are capable of working well in teams, who have good communication skills, and who are independent learners. We have tried to build all of these things into this course. But we don't expect to get it completely right first time. So, in the interests of improving this course, we're asking you to give us some feedback ... that is what the Student Course Experience Questionnaire is all about. We're not asking you to put your name on the survey.....we'd rather know how you really feel. If you enjoyed an activity and found it useful, say so and then we can make sure it stays as part of the course. If you found something to be a waste of time, say that also so that we can improve on it next year.The good news is that there is no need to prepare anything for this! It will all be explained by your facilitator.

Configuration Management Lecture

Configuration Management Quiz

Something to smile about .....

13

13 December - 19 December

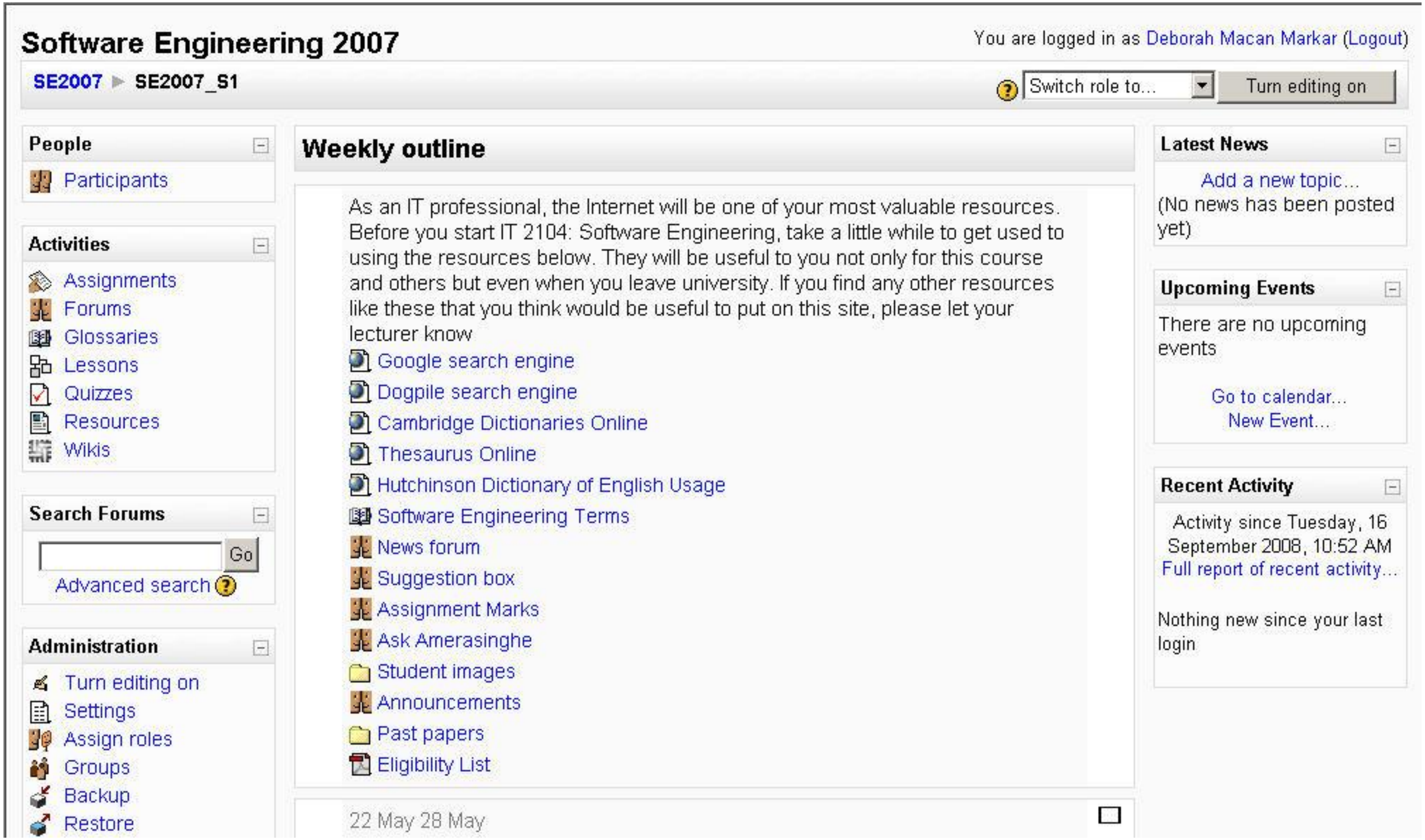
This is it ....you've finished....well almost. Just submit Assignment 3 online through Moodle before midnight on Wednesday, email your peer assessment sheets to your lecturer before the end of the week.....Oh and don't forget to submit your Reflections on Learning assignment on Monday (we did say **almost** finished didn't we) ..... and then you can relax and prepare for your exams. But that should be easy after having done all the quizzes shouldn't it!

- Computer-aided Software Engineering Lecture
- Computer-aided Software Engineering Quiz
- Peer Assessment Form - Assignment 3
- Something to smile about .....

You are logged in as Udayanthi Weerasooriya (Logout)

Home

Moodle™ Interface – 2007


Software Engineering 2007
You are logged in as Deborah Macan Markar (Logout)
SE2007 ▶ SE2007_S1
Switch role to...
Turn editing on
People
Participants
Activities
Assignments
Forums
Glossaries
Lessons
Quizzes
Resources
Wikis
Search Forums
Go
Advanced search
Administration
Turn editing on
Settings
Assign roles
Groups
Backup
Restore
Weekly outline
As an IT professional, the Internet will be one of your most valuable resources. Before you start IT 2104: Software Engineering, take a little while to get used to using the resources below. They will be useful to you not only for this course and others but even when you leave university. If you find any other resources like these that you think would be useful to put on this site, please let your lecturer know
Google search engine
Dogpile search engine
Cambridge Dictionaries Online
Thesaurus Online
Hutchinson Dictionary of English Usage
Software Engineering Terms
News forum
Suggestion box
Assignment Marks
Ask Amerasinghe
Student images
Announcements
Past papers
Eligibility List
22 May 28 May
Latest News
Add a new topic...
(No news has been posted yet)
Upcoming Events
There are no upcoming events
Go to calendar...
New Event...
Recent Activity
Activity since Tuesday, 16 September 2008, 10:52 AM
Full report of recent activity...
Nothing new since your last login

- Restore
- Import
- Reset
- Reports
- Questions
- Scales
- Files
- Grades
- Unenrol me from SE2007_S1

My courses

- Software Engineering 2007

All courses...

22 May 28 May

As this is our first week, our topic will be an "Overview of Software Engineering". In the list of resources below, you will find the lesson for this week. A copy of the lecture notes and an animated version of the lecture notes with a voiceover are available below. We have also prepared a quiz so that you can test your knowledge.

At FIT our focus is on professional development. This means that we need to understand what industry want and to graduate young professionals who have the right skills profile. Software Engineers, particularly, are IT professionals who need to have a skills profile which goes beyond mere technical knowledge. We have gone out to industry and recorded what leaders in industry here in Sri Lanka say about their expectations of new graduates seeking employment with them. You will find these videos on Lab_CD1 in the folder 'Graduate Attribute Videos'.

The CEOs in the videos, all emphasise the need for good teamworking, problem-solving and communication skills. In this course, we will focus on developing these skills...starting with a fun teambuilding activity 😊

- Overview of Software Engineering
- Overview of Software Engineering - Lecture Notes
- Overview of Software Engineering - Lecture Notes with Voiceover
- Overview of Software Engineering - Quiz

29 May 4 June

This week we look at Software Process Models. The lesson and the lecture notes for this week are below. You can find a version of the lecture notes with a recorded voiceover - so that you can hear the lecture being given at the same time as you watch the slides - on your Lab CD1.

This week we will look at the FILA process. This is a process used in professional development courses all over the world to teach problem solving skills. You will be using it to do your major assignment. Over the next few weeks we will be using your tutorials to study the process and what makes a good SRS so you will know exactly what is expected of you in your assignment.

How much of this theory do people in the industry really use? Well, earlier this year we went out to industry and asked professionals working in software development which, if any, of the software process models you will learn about this week they actually use. Check out the videos on your Lab CD2 to find out what the Technical Architect at Eurocenter and the Manager of Electronic Banking at HNB had to say on the subject.

- Software Process Models
- Software Process Models - Lecture Notes
- Software Process Models - Lecture Notes with Voiceover
- Software Process Models - Quiz
- The FILA process
- A PBL problem scenario
- FILA - The facts in the rooster story

5 June 11 June

If you watched the industry videos last week, you would know by now that software development houses don't stick to the textbook in terms of the software process models they use. Instead they use a combination of the approaches you have studied based on what works best for them and their clients. Many of them mentioned Agile approaches, so this week's lesson is on Rapid Software Development techniques including Agile methods such as Extreme Programming, RAD and prototyping.

As usual we have included a copy of the lecture notes and a quiz for you to practice with.

In this week's tutorial, we practice applying the FILA process to a real life software development example - developing a management information system for the Academy of Design in Colombo-03.

Rapid Software Development
Rapid Software Development - Quiz
SRS Template
Academy of Design Request for Tender

12 June 18 June

This week's lecture is not only important for IT2104 but also for your second year project. Gathering software requirements is a critical part of the software development process - especially for non-Agile approaches where the contract with the client is based on the SRS.

In this week's tutorial you continue your practice session of writing a SRS for the Academy of Design.

Software Requirements
Software Requirements - Lecture Notes
Software Requirements - Lecture Notes with Voiceover
Software Requirements - Quiz

19 June 25 June

19 June 25 June

This week's lecture is on Requirements Engineering. On the 11th and 12th July, you will be personally involved in some real life requirements engineering when you visit CarMart Ltd to elicit requirements for their Stock Ordering and Costing System.

In the tutorial this week, you continue your practice session of writing a SRS for the Academy of Design and fill in a questionnaire which will help you understand how to work better with your fellow team members.

- Requirements Engineering
- Requirements Engineering - Lecture Notes
- Requirements Engineering - Lecture Notes with Voiceover
- Requirements Engineering - Quiz
- Cognitive Style Inventory
- Myers-Briggs Type Indicators - what do they mean?

26 June 2 July

This week's topic is Project Management - a process you will be experiencing already with your second year project. This week you will start your main assignment. The assignment is split into 2 parts - Deliverable 1 and Deliverable 2 to reflect what usually happens in industry. In the requirements elicitation stage (**Deliverable 1 - due July 09**) you should use the documents provided by the client to try to identify all of the functional and nonfunctional requirements of the system. While you are doing this, you will find that there are a number of questions that you cannot answer using the Internet and other resources available to you and which you will need to ask the client directly. You get an opportunity to do this on **Tuesday 10th July**. In the requirements specification stage (**Deliverable 2 - due July 30**) you will write a SRS to describe the system. Both parts of the assignment are included below.

Deliverable 1 should be submitted online by clicking on the assignment link below. Deliverable 2 is to be done as a wiki.

- Project Management
- Project Management - Lecture Notes
- Project Management - Lecture Notes with Voiceover
- Project Management - Quiz
- Assignment - Deliverable 1 of 2
- Flowchart of Ordering Process
- Government Tariffs
- Assignment - Deliverable 2 of 2
- Assignment - Deliverable 2 Wiki
- Example of UML for Video Store

3 July 9 July

You're half way through the course and its holiday time. 😊 Well almost....don't forget that you have to have those questions ready for the people at CarMart by Monday !

In the meantime, what are the Myers-Briggs profiles of the members of your team? Are you all very similar or very different? How can you get on better? Take a look at your team profiles and get to know each other better.

5G
Aqua
Blossom
G2
G3
iFive
iSpy
Jeewana
Max5
Mind's Eye
Pansindu
Pramuka
Ranpahan
Sahana
Sansuka
Sharp Minds
Smart5
TechEd
Trojans

10 July 16 July

This week's topic is architectural design. This is the phase in software development that follows straight on from the requirements elicitation and specification stage. Actually you should already have given some thought to the architectural design at the time you write the SRS so it would be worthwhile thinking about this week's lesson before you write your assignment

Architectural Design
Architectural Design - Lecture Notes
Architectural Design - Lecture Notes with Voiceover

Architectural Design - Quiz

17 July 23 July

This week's topic is Verification & Validation. V & V are the process of finding out "Are we building the right product?" and "Are we building the product right?"

Verification & Validation

Verification and Validation - Lecture Notes

Verification and Validation - Quiz

24 July 30 July

This week's topic is Software Cost Estimation. Estimating the cost of a software development project is clearly something that you need to be able to do well if you are going to survive in business. However there are so many subjective parts to the process that some people say that cost estimation is an art more than a science.

Don't forget that your assignment is due **next Monday (July 30).**

Software Cost Estimation

Software Cost Estimation - Lecture Notes

Software Cost Estimation - Quiz

31 July 6 August

This week's topic is Software Maintenance and Evolution. It may surprise you to know that more programmer time goes into evolving or changing software systems over time than went into creating them in the first place. This week's lecture looks at this topic.

31 July 6 August

This week's topic is Software Maintenance and Evolution. It may surprise you to know that more programmer time goes into evolving or changing software systems over time than went into creating them in the first place. This week's lecture looks at this topic.

- Software Evolution
- Software Evolution - Lecture Notes
- Software Evolution - Lecture Notes with Voiceover
- Software Evolution - Quiz

7 August 13 August

This week's topic is Configuration Management. What sort of CASE tools are available to help you track all of the different versions of components in a software system? How do you keep track of changes made to the system over time? This is the final topic for IT2104. We hope that you enjoyed the course. Good luck with the exams.

- Configuration Management
- Configuration Management - Lecture Notes
- Configuration Management - Lecture Notes with Voiceover
- Configuration Management - Quiz

You are logged in as Deborah Macan Markar (Logout)

Home

Appendix E – Student Assessment Instruments

- **Assignments 1 - 3**
- **Marking rubrics**
- **Example peer assessment form**

Assignment 1: Team Web Site & Member Profiles

Due date: Wednesday 24th May, 2006 12:00 noon
Maximum grade: 10

Introducing Yourselves

1. By now you would have been assigned to a team. Choose one other student in your team. Sit down and have a chat with him or her. Find out as much as you can about where he/she comes from, why he/she choose to do IT at Moratuwa, what do they hope to do when they graduate, what are their interests or hobbies, where do they go for holidays and when they have weekends off, are they living with their family while they study or with other relatives or friends, what do they most enjoy about being a student at Moratuwa and what do they least enjoy about being a student here.
When you know your fellow team member inside out, **add his/her profile to the Participant's Profile in Moodle.**

2. Construct a team web page . The resource "Quick HTML Reference" will help you with this. Use Notepad or Word as the Quick HTML Reference suggests to build a basic web page or, if you want to really get into building web pages, Microsoft Frontpage is available on the computers in the student lab. Frontpage is a powerful web editor which is probably easier to work with than remembering HTML tags but takes a little time to learn. At this stage, we are more interested in the content of your web page than its technical sophistication.

Once your site is working well on your local computer, upload it following the instruction on Moodle.

What should be on the site?

- Your web page should have a team photo and show the team name and logo. List the names of team members so we know who they are from the photo.
- Do the "What sort of team player are you?" quiz. You can find the quiz and a guide for analysing the quiz results on the Moodle. For each of your team members, list their preferred role(s). What does all this mean about how your team will function? What problems are you likely to encounter? What are the strengths of your team profile? What can you do as a team to avoid likely problems and make the most of your strengths?
- List your team web site address on each team member profile.
- Draw up your Code of Ethics. (Refer to "What is a Code of Ethics and why does your team need one?")

Marking Scheme

Profile for each individual team member listed on	3

Moodle site	
Team Web Site	
- Team name and Logo	2
- Discussion of individual preferred Team Roles and what will be done to make the team work	3
- Code of Ethics	2
TOTAL	**10**

IT 114 - Software Engineering

Assignment 2: Using the 'Right' Model

http://192.248.11.37/ -> it114 -> Assignments -> **Assignment 2: Using the 'Right' Model**

Update this Assignment

View 10 submitted assignments

Assignment 2: Using the 'Right' Model

Due date: Friday, 12 November 2004, 04:30 PM (15 days 17 hours)
Maximum grade: 50

In this second assignment, you are expected to work as a team to present a case for using a particular Software Process Model to develop a given software application. In making your presentation, imagine that you are speaking to an audience which will include your boss (the Chief Technical Officer of your company) and the client (a non-technical person). Your team has been given a very short time on the meeting agenda (10 minutes) and your boss has told you to use it to convince the client that you have considered a number of different possible approaches to developing his product but have decided for good and sound reasons to use this particular model. Your boss is very particular about preventing meetings running overtime so take care not to upset her.

Case Studies

For this assignment, teams will be allocated one of five different case studies. For each case study a preferred Software Process Model has been nominated. The task of your team is to present good arguments to convince the client that the nominated Model is the right one for developing the application described in the case study. Case studies include:

1. A HIS for Asiri Hospital.

2. An online meter for CEB customers.

3. A web site for the School of Business Management.

4. A new IS for the University of Moratuwa Accounts Department.

5. A web portal for University of Moratuwa Projects.

Marking Scheme

The marking scheme for the assignment is given below. **This is a team mark**. A weak performance by any member of the team will result in a **poor grade for the whole team**. Don't let your team down!

Because different teams may be called to give presentations on different days, you are required to submit your powerpoint presentations at one time. This will make it fair for everyone. Your deadline to submit your presentation is 4.30pm Friday12th November. Your lecturer will let you know the schedule for presentations.

Oral Communication/Presentation Skills	5
Appropriateness of presentation material for audience	5
Quality and relevance of argument presented	20
Professional appearance of PowerPoint presentation	10
Professional appearance of presenter	5
Response to questions from the audience	5
TOTAL	50

…. 1. A HIS for Asiri Hospital

Asiri Hospitals Limited – Hospital Information System

Description

Asiri Hospitals Limited is one of the leading hospitals in Sri Lanka. This Hospital has been built and equipped to conform to International Standards and offers total healthcare and a courteous service to patients when they need it most. A team of experienced and dedicated Doctors, nurses and paramedical personnel with supporting staff are available at all times.

The computerization and automation of the everyday work of Asiri Hospitals is planned for development as a comprehensive Hospital Information System (HIS). This HIS has to be a complete knowledge based system for Asiri Hospitals Limited. It will support not only the routine applications of a HIS including ADT, Order Entry/Charge Capture, Pharmacy, Radiology, Nursing documentation and ICU Monitoring, but will also support a robust decision support function. The decision support system will be actively incorporated into the functions of the routine HIS applications. Decision support will be used to provide alerts/reminders, data interpretation, patient diagnosis, patient management suggestions and clinical protocols.

Goals and Objectives

- Activation of the decision support system should be provided interactively within the applications and asynchronously through data and time drive mechanisms.
- The data driven activation has to be instantiated as clinical data and to be stored in the patient's computerized medical record.
- Time driven activation of medical logic has to be triggered at defined time periods.
- The HIS should support an integrated database structure, which facilitates the decision support functions of HIS.

The development of any HIS is naturally a very complex process. In the case of Asiri Hospital, every division is eager for your team to start work on their systems as soon as possible. They don't want to wait for other systems to be developed first. As systems are developed they will need to be linked so that you can always demonstrate to the users an integrated system, even if system development is still at an early stage.

Your task:

- **Suppose that the best Software development process model that you can apply for this project is the Evolutionary Development model.**
- **You should be able to provide reasons for selecting the Evolutionary Development Model as the appropriate model for this project.**
- **The report should be in the form of a team presentation with EACH member of the team presenting.**

Pointers for brainstorming: *(Use these to start your team discussion …)*

1. Define the terms ADT and Order Entry/Charge Capture.

2. What is the function of a decision support system (DSS)? Where does the data for the Asiri Hospital DSS come from?

3. The description of the new HIS states that the DSS will be used to provide alerts/reminders, data interpretation, patient diagnosis, patient management suggestions and clinical protocols. What sorts of alerts/reminders do you think the DSS should generate? How could it help with patient diagnosis?

4. Is the database of the DSS separate from the HIS database or part of it? Why do you think this is a good design decision?

5. What are the characteristics of the Evolutionary Development Model?

…. 2. An online metre for CEB customers

Ceylon Electricity Board – Real Time Metering System

Description
The CEB has a statutory duty to develop and maintain an efficient, coordinated and economical system of Electricity Supply. It is also the duty of the CEB to generate or acquire supplies of electricity; to construct, maintain and operate the necessary works for the generation of electricity by all means, to construct, maintain and operate the necessary works for the inter-connection of Generating Stations and Sub-stations and for the transmission of electricity in bulk from Generating Stations and Sub-stations to such places as may be necessary from time to time; to distribute and sell electricity in bulk or otherwise.
CEB also has to exercise its powers and perform its functions so as to ensure that the revenue of the CEB is sufficient to meet its total outgoings and to meet a reasonable proportion of the cost of the development of the services of CEB.

This Real Time Metering system is to be designed to help customers of the CEB to understand their energy use so that they can manage it better and save money. The RTM Program provides real-time electricity meters to large commercial customers throughout the country. These meters are for customers with electrical demands of 200 kilowatts or more. The meter readings will be available on a real time basis on the CEB website. Typical facilities of this size include shopping malls, department or large retail stores, small manufacturing facilities, and medium to large office buildings.

Goals and Objectives

- Provide energy users with detailed information on their usage so they can better manage their usage and, preferably, reduce their peak and total usage.
- The meters should also make it possible for customers to participate in a variety of peak demand reduction programs in which customers are paid for reducing their electricity use during peak hours.

As they start to use the on line metering system, CEB will approach their customers for their feed back on the new system and to see if there are additional functions that they require.

Your task:

- **Suppose that the best Software development process model that you can apply for this project is Prototyping.**
- **You should be able to provide reasons as to why you selected Prototyping as the most suitable model for this project.**
- **Please note that the report should be in the form of a team presentation with EACH member of the team presenting.**

Pointers for brainstorming: *(Use these to start your team discussion …)*

1. How does the CEB calculate the cost of electricity to the consumer? Is it a standard cost for every kWh consumed?

2. How will the Real Time Metering system help large CEB customers?

3. Does the CEB have a clear idea right now of all the functional requirements of the Real Time Metering system?

4. How should CEB go about getting feedback from its customers?

5. Describe the Prototyping software development process model.

…. 3. A website for the School of Business Management

High School of Business Management - Web Site

Description

The High School of Business Management (HSBM) was established in 1968 under the purview of the Ministry of Industries and Scientific Affairs in collaboration with the UNDP, with the ILO functioning as the executing agency. On first June 1976, the Institute was incorporated as the High School of Business Management (HSBM). Since its establishment, the HSBM has aimed at achieving excellence in the programs it offers to clients who are drawn from both the public and private sectors of Sri Lanka, as well as those from overseas countries who have availed themselves of its services. The Main objectives of the Institute are as follows :

- To provide Business Management Education and Training.
- To provide Management Consultancy and Advisory Services.
- To facilitate the improvement of Business Productivity.

These objectives are achieved through the following divisions established by the Institute

- The Management Development Division.
- The Productivity Facilitation Division.
- The Consultancy Division.

HSBM have approached you to develop a web site for them. As a systems analyst you have interviewed Mr.N.Perera Director – Business Management Division, HSBM. Here is the record of the conversation.

> Mr.Perera : "Chandana", I want your people to develop a nice website to promote our Education and Training programs and Consultancy and Advisory Services. There are some other features that we may need to add as well but before doing that we have to discuss the matter in the board meeting next month. In any case the important things is to get a web presence as soon as possible. All of our competitors have websites and we are being left behind. As long as you can put up the basic information, we can agree on the additional features after the board meeting.
> Chandana : It doesn't matter Sir, I can start developing the web site with the details that you have given to me earlier.
> Mr.Perera : Good and we could show the site to the board of directors at the board meeting. That may convince them to approve the rest of it.
> Chanadana : Exactly when is the board meeting sir?
> Mr.Perera : On the 20th. Does it give you enough time?
> Chanadana : Yes. No problem.

Goals and Objectives

- Promote Business Management Education and Training within the premises and beyond the HSBM.
- Promote Management Consultancy and Advisory Services.
- Locate (search and browse) existing information at HSBM.

Your task:

- **Suppose that the best Software development process model that you can use for this project is the Incremental Model.**
- **You should be able to provide reasons for selecting the Incremental Model as the most suitable model for this project.**
- **Please note that the report should be in the form of a team presentation with EACH member of the team presenting.**

Pointers for brainstorming: *(Use these to start your team discussion …)*

1. Do you think that Mr Perera sees the web site as a promotional web site for HSBM or as a tool to help improve business productivity in Sri Lanka or both?

2. Do you think that the rest of the board will agree with Mr. Perera's vision for the web site?

3. Which of the three main objectives of the HSBM will Chandana's web site support?

4. Describe the Incremental software development process model.

…. 4. A new IS for the University of Moratuwa Accounts Department

University of Moratuwa – Payroll System

Description

The University of Moratuwa is one of the leading technical Universities in Sri Lanka. The University promotes its services as a center of higher learning, research & consultancy in Information Technology, Engineering, Architecture & other allied Professional disciplines. It has a number of different faculties, departments and sub-departments that are associated with different functions.

The Computerization and Automation of the Accounts Department of the University of Moratuwa , was taken up on an experimental basis as a precursor to the complete Computerization and Automation of administrative work at University of Moratuwa . The Accounts Department is organized in a highly structured manner. The Bursar of the department is responsible for all the activities of the department. Below the Bursar is the Deputy Bursar.

Up until now, the administrative work of the Accounts Department has been carried out on a wholly manual basis involving cumbersome housekeeping and hierarchical procedures. A number of registers are maintained resulting in redundant operations such as the entry of similar information to the different registers. This is very common for personnel data because the same data is used in a number of different systems. It is necessary to automate the whole process with the personnel data sub system the first to be developed.

Once this sub system is operational and is being properly used by the staff of the Accounts Department, the next sub system targeted for development will be the messaging system as the inability to communicate with other members of staff in a timely fashion is one of the main weaknesses of the current manual system. Often the need arises to pass an internal memo or message or for some document to be sent urgently to a higher authority to expedite the processing in some matter. The failure of existing manual communications systems is one of the main reasons for the poor efficiency of the Accounts Department.

It is important that each sub system be signed off by the Bursar as it is accepted so that your company can invoice for payment.

Your task:

- **Suppose that the best Software development process model that you can apply to this project is the Waterfall Model.**
- **You should be able to provide reasons for selecting the Waterfall model as the most suitable model for this project.**
- **Please note that the report should be in the form of a team presentation with EACH member of the team presenting.**

Pointers for brainstorming: *(Use these to start your team discussion ...)*

1. Is it clear which functions of the Accounts Department should be developed and in which order?

2. Are there likely to be other university accounts departments with automated sofware systems?

3. Is it clear what data needs to go into the new database(s)?

4. How difficult will it be to design the forms and reports to be used by the Accounts Department?

5. Describe the Waterfall software development process model.

…. 4. A web portal for University of Moratuwa Projects

University of Moratuwa - Faculty of IT – IT Projects Web Portal

Description
The University of Moratuwa is one of the leading technical Universities in Sri Lanka. The University promotes its services as a center of higher learning, research & consultancy in Information Technology, Engineering, Architecture & other allied Professional disciplines. The planned web portal will provide access to IT projects at the IT Faculty of the University of Moratuwa. The portal is intended to promote the University of Moratuwa's IT Faculty IT projects within the University and beyond. It will allow the faculty to view their colleagues' projects from across the University and submit information on their own projects.

Goals and Objectives

A large amount of faculty project material already exists on the uom.edu.lk domain. This project will attempt to bring these resources together into one portal. Simply building a web site is not enough. A major objective of this project is to generate interest, raise awareness, and actively promote the use of the portal.

Stages :

Stage 1 : Promote the University of Moratuwa IT Faculty IT projects within the University and beyond. This includes prospective student recruitment, funding acquisition, and general exposure for notable projects.
Stage 2 : Locate (search and browse) project profiles at other institutions. Provide information on starting a new project: support, resources, and funding availability.
Stage 3 : There is also an enormous amount of material on the web that pertains to the use of IT in higher learning. A longer-term goal of this project is to include a database of links to these external resources.

Your company has been asked to develop Stage 1. Once Stage 1 is online, university users will be surveyed as a form of acceptance testing. Acceptance of Stage 1 by the university community is an essential pre-requisite for funding to be allocated to the development of Stage 2.

Your task:

- **Suppose that the best Software development process model that you can apply to this project is the Spiral Model.**
- **You should be able to provide reasons as to why you selected the Spiral Model as the most suitable model for this project.**
- **Please note that the report should be in the form of a team presentation with EACH member of the team presenting.**

Pointers for brainstorming: *(Use these to start your team discussion …)*

1. What are the goals of the new portal?

2. Who is the target audience?

3. What sorts of skill profiles should the people in the software development team have?

4. Is Stage 1 likely to have a short, medium or long term development lead time?

5. Describe the Spiral software development process model.

Software Engineering 2007

Jump to...

SE2007 ► SE2007_S1 ► Assignments ► Assignment - Deliverable 1 of 2

Update this Assignment

View 0 submitted assignments

SE2104 Assignment 3 – Deliverable 1

Questions for Requirement Specification Briefing

Carmart Limited is the sole agent, authorized repairer, and spare parts distributor for Mazda and Peugeot in Sri Lanka. Founded in 1953, Carmart is one of the longest running automobile importers in Sri Lanka, and also one of the oldest continuously operating distributors for its franchises in the Asian region. Carmart employs 153 people with showrooms and adjoining workshop facilities in inner-city Colombo and at a larger aftersales site in Ratmalana with facilities for accident repair. The Colombo facility is fully networked with an online system connecting the business to manufacturers in Europe and Japan. Its operations are currently supported by computerized Inventory Management, Job Costing and Accounting systems.

Carmart would like to develop a Stock Ordering and Costing System (SOCS) to interface to their Inventory Management System which was developed by DMS and which runs on Oracle under Windows 2000. While the Inventory Management System keeps track of current stock levels, CarMart also needs a system which will predict numbers and types of parts that should be ordered such that stock levels are never too low nor held in surplus. This is a critical tool for CarMart with over 15,200 line items to be tracked.

Overview of desired system operation

When an order is placed with a manufacturer, the manufacturer will confirm which items of stock they can supply ex-stock. Any items of stock that the manufacturer cannot supply ex-stock must be placed on back-order. The manufacturer will then supply Carmart with an invoice and freighting details. Where the parts will be sent by sea-freight a Letter of Credit (LC) must be established for payment. Where air-freight is used the payment should be made by Telegraphic Transfer (TT).

When the goods arrive at Sri Lankan customs, Carmart needs to supply Customs with a list of the goods in the shipment and respective Harmonized Standard Codes. Duty rates depend on the type of item with rates for different types of goods being set down in the Harmonized Standard Codes (HSC) directory maintained by Customs. All charges are entered into a Customs Clearance Form. SOCS should be self-learning in that where customs rates for a particular line item have been entered once, this information should be recorded against the item number in the system so that the entry does not need to be repeated.

SOCS should produce a Forward Costing Estimate made at the time the goods are ordered and which can be compared later with an Actual Cost figure. The costing estimate should take into account the cost of the part from the manufacturer, customs duties, and other costs of importation. The manufacturer is paid as soon as the invoice is produced and prior to shipping, unless there is a credit arrangement, in which case payment is affected within the credit period. Customs charges are levied at the time the goods are cleared. Hence in calculating costs in rupees, exchange rates estimates will need to be used. Freight charges and bank charges are not known at the time of ordering and should be added to the system when known so that the Actual Cost can be generated.

SOCS will need to interface with the Inventory Management system. It will be sufficient for SOCS to share a database table with the Inventory Management system that is updated whenever stock is added to the warehouse (ie at Goods Received Time). Alterations to the Inventory Management System will be done by DMS but the interface must be specified as part of this Requirements Specification.

Domain-specific Information

- An order of spare parts, consisting minimally of part numbers and quantities is called an "Indent".
- SOCS must be able to handle costings in multiple currencies (e.g. freight in US$, parts cost in Euro, customs duties in Rupees).
- Manufacturers send spare parts price lists to Carmart on CD.
- Damaged or missing parts will only be known at Goods Received Time (GRT).
- The Central Bank faxes a list of Exchange rates (dollar, euro and yen) to CarMart each morning. The Central Bank also provides forward estimates of exchange rates for 6 months into the future.
- Customs maintain their own exchange rates that apply for clearance of goods. These rates are independent of Central Bank rates, and are released every Monday, with a 5 day validity.
- The demand for different items of stock varies on a seasonal basis (ie. a demand for windscreen wipers in the wet season) and information about seasonal trends can be obtained from past inventory level data kept in the Inventory Management System.
- Stock may need to be ordered well in advance if it will be sea freighted (3 month lead time) or a little in advance if it will be air-freighted (approximately a 2 week lead time).
- Orders that will be paid by telegraphic transfer (TT) cannot exceed USD 10,000 in value (approx. € 8,000) because of Central Bank restrictions on the value of individual TTs (telegraphic transfers). There is no value restriction on a letter of credit (LC).

Deliverable One

Your team should generate a list of questions to be sent to Mr. Yasendra Amerasinghe the Director, Operations of CarMart. The list of questions should be formatted as a letter to Mr. Amerasinghe requesting clarification of the system description given above. The list of questions should be uploaded to Moodle before cob (close of business = 5pm) **Monday 09 July,** to be forwarded to Mr. Amerasinghe in sufficient time for him to read them before the briefing. In the briefing on Tuesday 10th July, Mr Amerasinghe will answer your written questions and you will have the opportunity to ask further questions. The briefing will be conducted in English. Because of space constraints in the CarMart Board Room, you will have to elect only one (1) member of your team to attend the briefing. This may or may not be your Team Leader.

Any team not submitting a request for clarification to the Moodle (the deliverable) **will not be eligible to send a representative to the briefing.**

The briefing will take place at the CarMart showroom at 2pm on Tuesday, 10th July (for Wednesday tutorial groups) and at 4pm on Tuesday, 10^{th} July (for Thursday tutorial groups).

Support Documents (on Moodle)

- Calculating Government Tariffs
- Flowchart of Ordering Process

Software Engineering 2007

Jump to...

SE2007 ▶ SE2007_S1 ▶ Assignments ▶ **Assignment - Deliverable 2 of 2**

Update this Assignment

View 0 submitted assignments

Assignment 3: Deliverable 2

SRS Documentation

For this assignment, you are required to produce a Systems Requirement Specification Document for a real organisation operating in Colombo. Your team will be required to interview the client and produce the SRS Document based on your findings.

Background to the Problem

Refer Assignment – Deliverable 1

Your Tasks

Mr. Yasendra Amerasinghe the Director, Operations of CarMart Ltd has approached your company to design a Stock Ordering and Costing System (SOCS) for them. Your boss has assigned your team to the Client Acquisition Phase of this project. You will send your business analysts to meet the client (Part 1 of this assignment) and prepare a Software Requirements Specification (SRS) Document describing the system that you would design for CarMart. As the 'Costing' part of the SOCS system will be introduced in a later increment, it is **not** necessary to include any costing components in the functional requirements section of the SRS. To prepare the SRS, you will use your company SRS template.

Resources:

1. Assignment – Deliverable 1
2. Calculating Government Tariffs
3. Flowchart of Ordering Process
4. Company SRS template.

Marking Scheme

Section 1 - Introduction	10
Section 2 - Overall Description	10
Section 3 - Functional Requirements	50
Section 4 - External Interface Requirements	10

Section 1 - Introduction	10
Section 2 - Overall Description	10
Section 3 - Functional Requirements	50
Section 4 - External Interface Requirements	10
Section 5 - Nonfunctional Requirements	15
Use of software engineering terms and expressions	05
TOTAL	**100%**

Submission

You will work on this assignment in the Wiki space set up for you on the Moodle. The wiki is set up so that only the people in your group can see your wiki space. You should set up the first page of your wiki space to be the TOC from the template. Your instructors will tell you walk you through this in the first tutorial session after your visit to CarMart. The wiki space will be closed **at 5pm on Monday 30th July** after which time you will not be able to make any further changes to it.

Available from:	Sunday, 1 July 2007, 12:05 AM
Due date:	Monday, 30 July 2007, 05:00 PM

You are logged in as Deborah Macan Markar (Logout)

IT2104 Software Engineering : **Self and Peer Assessment Form**

Team Name ……………….. ASSIGNMENT 1

Scoring 6 = always, 5=mostly, 4=usually, 3 = sometimes, 2= occasionally, 1 = rarely, 0 = not at all

	You	Team member #1	Team member #2	Team member #3	Team member #4
• **Respond to all questions** • Enter team members alphabetically	Name and student number	Name and student number	Name and student number	Name and student number	Name and student number
Attended and contributed to all meetings **or** responded to all communications **or** made prior arrangements [1,2]					
Was prepared for all meetings **or** made prior arrangements[1]					
Contributed **positively** to ideas and solutions					
Took an **active role** in deciding tasks and a solution					
Undertook a **fair share** of tasks **or** made prior arrangements[1]					
Completed assigned tasks to **acceptable standard or** sought appropriate help if needed [3]					
Completed assigned tasks to the **agreed timeframe or** made prior arrangements[1]					
Adhered to code of conduct and cooperation[4]					
TOTAL					

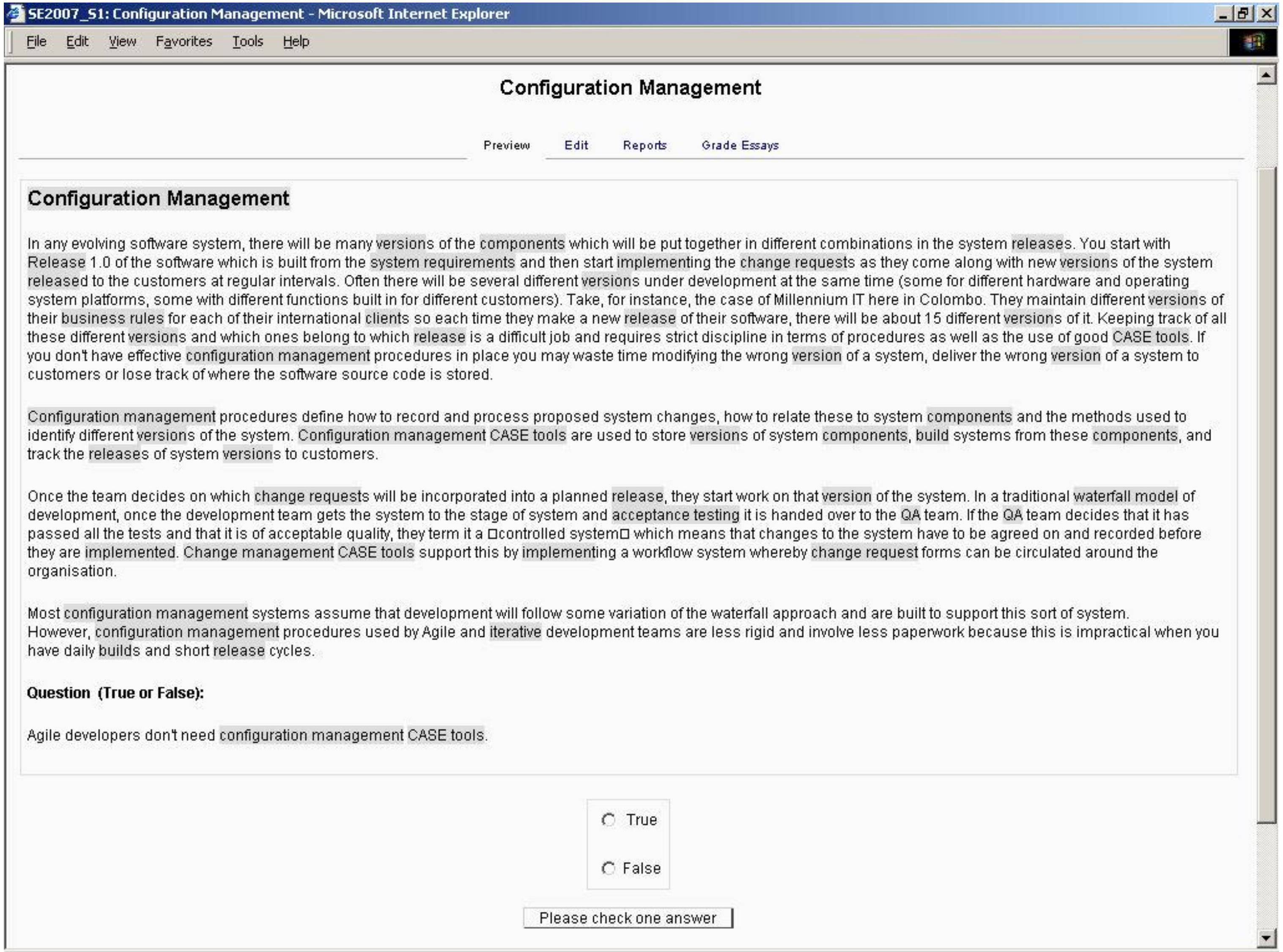
Notes: **If a student will be absent due to something beyond their control i.e. illness, work commitments etc and they let the group know and make arrangements agreeable to the group they should NOT be penalised. However if an absence is repeated and no effort is made to contact the group or alternative arrangements for work then this is NOT team work and should be scored accordingly**

1. A log of attendance and communication should be maintained by the team leader and members. This is evidence to support this score. In the event of an appeal over an individual's score these logs will be required.

2. Sometimes a task may be assigned to a student who has insufficient knowledge to satisfactorily complete the task e.g. operating a spreadsheet to produce a graph. It is important that ALL team members cover basic 'content' and help/guidance should be provided to support your colleagues.
3. One of the first tasks undertaken by the team is the development of a code of conduct. This sets out the 'rules' that the team will work by and the behaviours that govern the operation of the team.

Appendix F

Example of Moodle Lesson


SE2007_S1: Configuration Management - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Configuration Management

Preview Edit Reports Grade Essays

Configuration Management

In any evolving software system, there will be many versions of the components which will be put together in different combinations in the system releases. You start with Release 1.0 of the software which is built from the system requirements and then start implementing the change requests as they come along with new versions of the system released to the customers at regular intervals. Often there will be several different versions under development at the same time (some for different hardware and operating system platforms, some with different functions built in for different customers). Take, for instance, the case of Millennium IT here in Colombo. They maintain different versions of their business rules for each of their international clients so each time they make a new release of their software, there will be about 15 different versions of it. Keeping track of all these different versions and which ones belong to which release is a difficult job and requires strict discipline in terms of procedures as well as the use of good CASE tools. If you don't have effective configuration management procedures in place you may waste time modifying the wrong version of a system, deliver the wrong version of a system to customers or lose track of where the software source code is stored.

Configuration management procedures define how to record and process proposed system changes, how to relate these to system components and the methods used to identify different versions of the system. Configuration management CASE tools are used to store versions of system components, build systems from these components, and track the releases of system versions to customers.

Once the team decides on which change requests will be incorporated into a planned release, they start work on that version of the system. In a traditional waterfall model of development, once the development team gets the system to the stage of system and acceptance testing it is handed over to the QA team. If the QA team decides that it has passed all the tests and that it is of acceptable quality, they term it a □controlled system□ which means that changes to the system have to be agreed on and recorded before they are implemented. Change management CASE tools support this by implementing a workflow system whereby change request forms can be circulated around the organisation.

Most configuration management systems assume that development will follow some variation of the waterfall approach and are built to support this sort of system. However, configuration management procedures used by Agile and iterative development teams are less rigid and involve less paperwork because this is impractical when you have daily builds and short release cycles.

Question (True or False):

Agile developers don't need configuration management CASE tools.

True

False

Please check one answer

Software Engineering 2007

Jump to...

SE2007 ▸ SE2007_S1 ▸ Lessons ▸ Configuration Management

Update this Lesson | Edit page contents

Configuration Management

Preview | Edit | Reports | Grade Essays

Configuration Management Planning

In a large software system there may be thousands of source code modules, test scripts, design documents, and so on that you need to keep track of. These will usually be stored in a version management system (such as CVS) in such a way that the correct versions of each component can be retrieved automatically when it comes time to do a build or the correct suit of tests can be selected quickly.

There will also be other information related to these managed documents such as information about users of components, system customers, execution platforms, proposed changes and so on. This information is normally kept in files in a controlled directory structure, or in another database called the Configuration Management database.

There is the option of using a configuration database which is integrated with the version management system. This approach makes it possible to link changes directly with the documents and components affected by the change. Links between documents (such as design documents) and program code may be maintained so that you can find everything that you have to modify when a change is proposed. However, such integrated systems are expensive.

Imagine that you are put in charge of the configuration database for Millennium IT. Millennium IT has built a suite of capital market solutions which they maintain on behalf of customers all over the world. At any moment you might be called upon to answer questions such as,

1. Which customers have taken delivery of a particular version of the system?
2. What hardware and operating system configuration is required to run a given system version?
3. How many versions of a system have been created and what were their creation dates?
4. What versions of a system might be affected if a particular component is changed?
5. How many change requests are outstanding on a particular version?
6. How many reported faults exist in a particular version?

Clearly, to do this, you have to not only have a well designed configuration management database in place but you also need to have a clear configuration management plan which :

1. Sates what sort of information should be put into the CM database and what sorts of files should be stored in the version management system. It should also describe how each sort of file should be named (naming convention).
2. Describes the structure of the CM database and where each item of information should be stored.
3. States who is responsible for putting what into the database.

There should also be a clear team policy on which configuration management CASE tools should be used and everyone should be trained how to use them.

Question :

One of Millennium IT's customers for its capital markets software is the Boston Stock Exchange. Where would you expect Millennium to keep information about the hardware platforms the Boston Stock Exchange runs its software on?

- In their version management system.
- In their configuration management database
- In a controlled directory structure.

Please check one answer

Software Engineering 2007

Jump to...

SE2007 ▸ SE2007_S1 ▸ Lessons ▸ Configuration Management

Update this Lesson | Edit page contents

Configuration Management

Preview | Edit | Reports | Grade Essays

Configuration Item Identification

So what sorts of things should be put into the version management system database? Basically project plans, requirements specifications, design documents, code modules and test data suits should be included along with anything that may be useful for future system evolution and is related to a particular version of the system. Things like minutes of meetings, memos etc that nobody will want to read 6 months from now, should not.

Clearly, even in the smallest of systems, keeping just these few things is going to mean storing thousands of documents. Since this is the case, there needs to be a clear naming convention so that you don□t end up giving the same name to two different documents or source code modules.

This name may reflect the type of item, the part of the system that it applies to, the creator of the item and so on. It might be hierarchical to reflect the relationship between items. For instance you might define a naming scheme with names such as,

PCL-TOOLS/EDIT/FORMS/DISPLAY/AST-INTERFACE/CODE

PCL-TOOLS/EDIT/FORMS/DISPLAY/AST-INTERFACE/OBJECTS

PCL-TOOLS/EDIT/FORMS/DISPLAY/AST-INTERFACE/TESTS

PCL-TOOLS/EDIT/FORMS/DISPLAY/FORM-IO/CODE

PCL-TOOLS/EDIT/FORMS/DISPLAY/FORM-IO/OBJECTS□.

The initial part of the name is the project name, PCL-TOOLS. In this project, there are a number of separate tools being developed, so the tool name (EDIT) is used as the next part of the name. Each tool includes differently named modules whose name makes up the next component of the item name (FORMS, HELP) and so on all the way down to the individual component. As you can see, in this example, three formal items are required for each code component : an object description (OBJECTS), the source code of the component (CODE) and a set of tests for that component (TESTS).

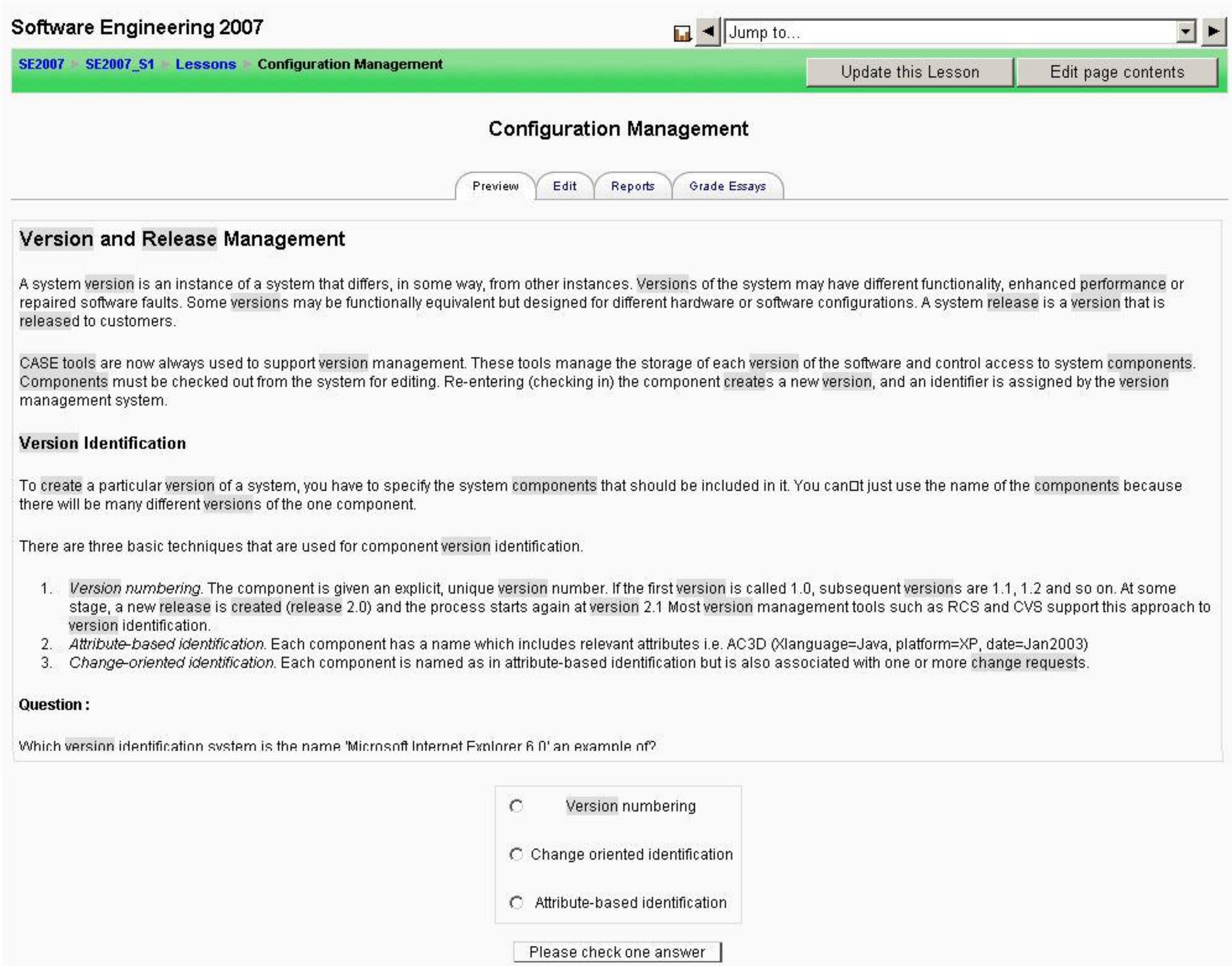
Hierarchical naming schemes are simple and easily understood, and sometimes they can map to the directory structures used to store project files. However problems arise when you share components between projects because the names are no longer appropriate.

Question :

Which process model would it be impossible to use a hierarchical naming scheme with?

- Evolutionary development model
- Waterfall model
- CBSE model
- Iterative development model

Please check one answer



Software Engineering 2007

Jump to...

SE2007 ▸ SE2007_S1 ▸ Lessons ▸ Configuration Management

Update this Lesson | Edit page contents

Configuration Management

Preview | Edit | Reports | Grade Essays

Version and Release Management

A system version is an instance of a system that differs, in some way, from other instances. Versions of the system may have different functionality, enhanced performance or repaired software faults. Some versions may be functionally equivalent but designed for different hardware or software configurations. A system release is a version that is released to customers.

CASE tools are now always used to support version management. These tools manage the storage of each version of the software and control access to system components. Components must be checked out from the system for editing. Re-entering (checking in) the component creates a new version, and an identifier is assigned by the version management system.

Version Identification

To create a particular version of a system, you have to specify the system components that should be included in it. You can□t just use the name of the components because there will be many different versions of the one component.

There are three basic techniques that are used for component version identification.

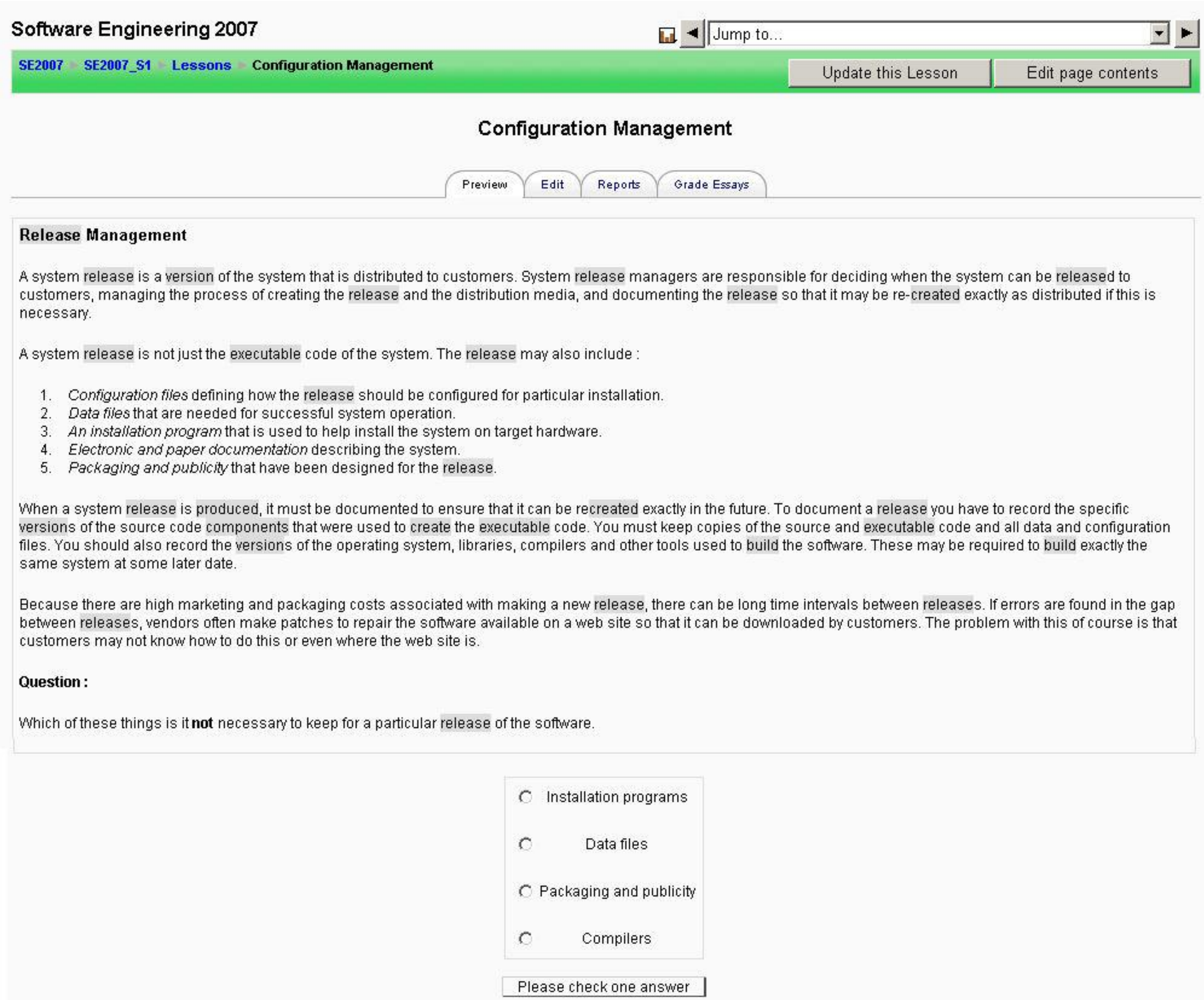
1. *Version numbering*. The component is given an explicit, unique version number. If the first version is called 1.0, subsequent versions are 1.1, 1.2 and so on. At some stage, a new release is created (release 2.0) and the process starts again at version 2.1 Most version management tools such as RCS and CVS support this approach to version identification.
2. *Attribute-based identification*. Each component has a name which includes relevant attributes i.e. AC3D (Xlanguage=Java, platform=XP, date=Jan2003)
3. *Change-oriented identification*. Each component is named as in attribute-based identification but is also associated with one or more change requests.

Question :

Which version identification system is the name 'Microsoft Internet Explorer 6.0' an example of?

- Version numbering
- Change oriented identification
- Attribute-based identification

Please check one answer


Software Engineering 2007

Jump to...

SE2007 ▸ SE2007_S1 ▸ Lessons ▸ Configuration Management

Update this Lesson | Edit page contents

Configuration Management

Preview | Edit | Reports | Grade Essays

Release Management

A system release is a version of the system that is distributed to customers. System release managers are responsible for deciding when the system can be released to customers, managing the process of creating the release and the distribution media, and documenting the release so that it may be re-created exactly as distributed if this is necessary.

A system release is not just the executable code of the system. The release may also include :

1. *Configuration files* defining how the release should be configured for particular installation.
2. *Data files* that are needed for successful system operation.
3. *An installation program* that is used to help install the system on target hardware.
4. *Electronic and paper documentation* describing the system.
5. *Packaging and publicity* that have been designed for the release.

When a system release is produced, it must be documented to ensure that it can be recreated exactly in the future. To document a release you have to record the specific versions of the source code components that were used to create the executable code. You must keep copies of the source and executable code and all data and configuration files. You should also record the versions of the operating system, libraries, compilers and other tools used to build the software. These may be required to build exactly the same system at some later date.

Because there are high marketing and packaging costs associated with making a new release, there can be long time intervals between releases. If errors are found in the gap between releases, vendors often make patches to repair the software available on a web site so that it can be downloaded by customers. The problem with this of course is that customers may not know how to do this or even where the web site is.

Question :

Which of these things is it **not** necessary to keep for a particular release of the software.

- Installation programs
- Data files
- Packaging and publicity
- Compilers

Please check one answer

Software Engineering 2007

Jump to...

SE2007 ▸ SE2007_S1 ▸ Lessons ▸ Configuration Management

Update this Lesson | Edit page contents

Configuration Management

Preview | Edit | Reports | Grade Essays

System Building

System building is the process of compiling and linking software components into a program that executes on a particular target configuration. Firstly the component is compiled to convert its English-like programming language into machine code. Then the various components are linked to form the executable program.

Software configuration management tools or, sometimes, the programming environment are used to automate the system-building process. The CM team writes a build script that defines the dependencies between the system components. This script also defines the tools used to compile and link the system components. The system-building tool interprets the build script and calls other programs as required to build the executable system from its components. In some programming environments (such as Java development environments) the build script is created automatically by parsing the source code and discovering which components are called.

CASE tools for configuration management

When a system is built from multiple versions of many different components, it is almost impossible to do the job accurately without CASE tools. There are two approaches :

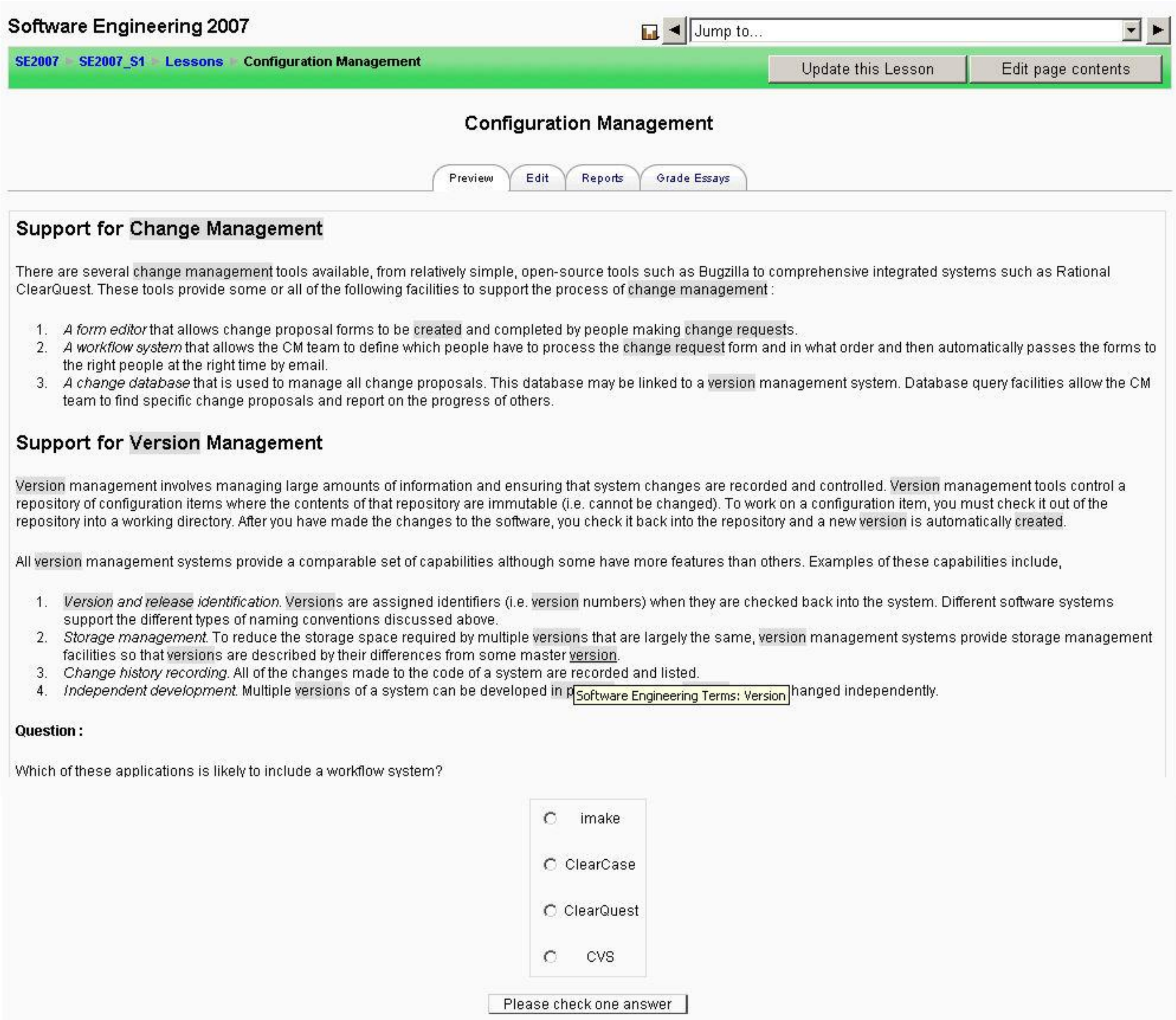
1. *Using an open workbench.* Different tools are used for different parts of the task and the CM process is integrated by sticking to strict organisational procedures. You might use bug-tracking tools such as Bugzilla, version management tools such as RCS or CVS and system building tools such as make or imake. These are all opensource tools that are freely available.
2. *Using an integrated workbench.* These workbenches provide integrated facilities for version management, system building and change tracking. For example, Rational□s Unified Change Management process relies on an integrated CM workbench incorporating ClearCase for system building and version management and ClearQuest for change tracking. However such workbenches are usually very complex and expensive and many organisations prefer to use cheaper and simpler individual tools.

Question:

Which of the following is an opensource CASE tool for system building?

- imake
- ClearQuest
- Bugzilla
- CVS

Please check one answer



Software Engineering 2007

Jump to...

SE2007 ▸ SE2007_S1 ▸ Lessons ▸ Configuration Management

Update this Lesson | Edit page contents

Configuration Management

Preview | Edit | Reports | Grade Essays

Support for Change Management

There are several change management tools available, from relatively simple, open-source tools such as Bugzilla to comprehensive integrated systems such as Rational ClearQuest. These tools provide some or all of the following facilities to support the process of change management :

1. *A form editor* that allows change proposal forms to be created and completed by people making change requests.
2. *A workflow system* that allows the CM team to define which people have to process the change request form and in what order and then automatically passes the forms to the right people at the right time by email.
3. *A change database* that is used to manage all change proposals. This database may be linked to a version management system. Database query facilities allow the CM team to find specific change proposals and report on the progress of others.

Support for Version Management

Version management involves managing large amounts of information and ensuring that system changes are recorded and controlled. Version management tools control a repository of configuration items where the contents of that repository are immutable (i.e. cannot be changed). To work on a configuration item, you must check it out of the repository into a working directory. After you have made the changes to the software, you check it back into the repository and a new version is automatically created.

All version management systems provide a comparable set of capabilities although some have more features than others. Examples of these capabilities include,

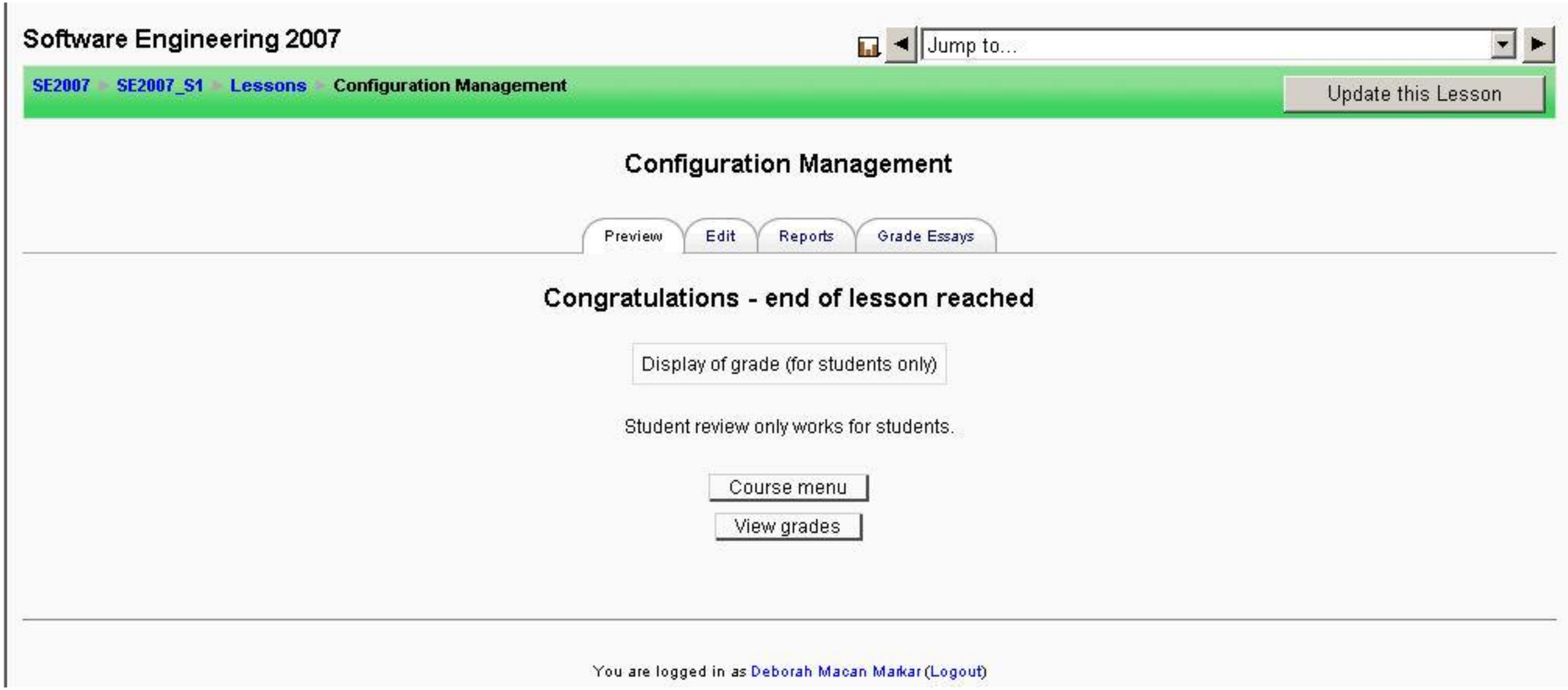
1. *Version and release identification.* Versions are assigned identifiers (i.e. version numbers) when they are checked back into the system. Different software systems support the different types of naming conventions discussed above.
2. *Storage management.* To reduce the storage space required by multiple versions that are largely the same, version management systems provide storage management facilities so that versions are described by their differences from some master version.
3. *Change history recording.* All of the changes made to the code of a system are recorded and listed.
4. *Independent development.* Multiple versions of a system can be developed in p Software Engineering Terms: Version hanged independently.

Question :

Which of these applications is likely to include a workflow system?

- imake
- ClearCase
- ClearQuest
- CVS

Please check one answer



Software Engineering 2007
Jump to...
SE2007 SE2007_S1 Lessons Configuration Management
Update this Lesson
Configuration Management
Preview
Edit
Reports
Grade Essays
Congratulations - end of lesson reached
Display of grade (for students only)
Student review only works for students.
Course menu
View grades
You are logged in as Deborah Macan Markar (Logout)