

## Problem-based Learning – is it right for Sri Lanka?

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**Abstract:** Employers in the ICT sector in Sri Lanka are concerned about the soft skills of the graduates they employ. The training sector is aware of their concerns but find it challenging to nurture the appropriate skills and attitudes in students used to traditional, teacher-centred learning environments. Elsewhere in the world, problem-based learning has provided a solution for similar scenarios. However the learning environment in the Sri Lankan university sector challenges some of the basic assumptions generally made in implementing PBL i.e. that there will be free and open dialogue between students, that student teams will recognise each other as equal peers, that facilities to accommodate small group work can be made available. This paper describes a partially successful venture to introduce PBL to the public university system in Sri Lanka and identifies modifications that need to be made to the model in future implementations.

**Keywords:** Problem-based learning, PBL, Soft Skills, Tertiary Education, Sri Lanka

The IT faculty at the University of Moratuwa in Sri Lanka are faced with a challenge. The challenge is not falling enrolments. There is no lack of demand for places. Students in Sri Lanka compete for university places from the early years of primary school; only 3% of the age cohort (adb, 2003) secure admission to the public university system and many of these wait for years for a place. Nor is there a lack of demand for IT graduates in the country (CSSL 2000/2001; SLICTA 2005). The problem is a critical mismatch between the output of the public education system and the needs of employers.

Asanka's story illustrates the problem well.

*Asanka is a typical student entering the Faculty of Information Technology. He comes from a secondary town about 100 km away from Colombo. His parents have been pushing him to do well at school since before the Year 5 scholarship exam<sup>1</sup> because they said that if he didn't get into a good school after scholarship, he wouldn't be able to get good G.C.E results. When he started his G.C.E 'O' levels they enrolled him in a tutoring class<sup>2</sup>*

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<sup>1</sup> 'The Year 5 primary scholarship examination, introduced originally in 1944 to admit poor, able children to central schools in rural areas, has gained strength over the past 20 years and continues to dominate the teaching and learning practices of teachers in most primary schools. Success in the scholarship exam leads to a means-tested bursary and privileged access to a prestigious school' Little, A. W. 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: 67-86.

<sup>2</sup> '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', Ibid.

*recommended by their friends whose eldest daughter had just started medicine at university. He didn't have much free time but he was not alone. Over 300 students attended the tutorial classes reviewing past exam papers and learning how to answer the questions. At school and in the tutorial classes he studied in Sinhala<sup>3</sup> but he knew that he had to do very well in English because that was the language used at university. He was good at maths so his parents encouraged him to apply for Engineering. You will get a good, secure, and well-paid job as an engineer, they told him. Finally he finished his 'A' levels. Asanka wanted to relax and spend some time with his younger brother after all that cramming but his friends had all enrolled in short courses to build up their curriculum vitae and improve their employability. Asanka thought he should do some computing courses because they hadn't done anything at school and he'd put IT as his 3<sup>rd</sup> choice on the university enrolment form so he enrolled in a Microsoft Office course at a private training centre<sup>4</sup>. Before he finished the course, he got his results. Not enough marks to do the Engineering course he wanted to do but he had been accepted to do Information Technology. He asked his friends what they thought. You can also get a good job in IT with one of the big software companies they told him. So he came to study at the Faculty of Information Technology.*

*In the first week of his new course, his lecturer told the class to listen to a video of several local ICT employers explaining what skills they looked for in a new graduate. All of the employers spoke in English. They seemed to talk a lot about teamwork and communication skills; about the attitudes they thought were important and about the need for employees in the ICT industry to keep learning even beyond university. Asanka was surprised. He didn't have much experience in IT but he thought that to be a good IT professional, the most important thing must be to have good practical skills in programming, networking and computer hardware.*

*However, his lecturers certainly seemed to take this teamwork idea seriously. A lot of the time he found he was supposed to work in a small group. He'd never done this at school. It was nice to work with other students but not everyone in the group worked hard and Asanka was worried about his grades. It was also hard to talk to some of the people in his team who didn't speak Sinhala very fluently. Some of his team mates were pretty fluent in English but everyone felt more comfortable talking in Sinhala or Tamil<sup>5</sup>. In some ways it was easier when he'd been at school because as long as he studied hard and paid attention in the tutorial sessions, he knew he'd get good marks. He decided that his group would get good marks even if he had to do the whole assignment himself. His lecturer had made him a team leader so, as it came time to do each assignment, he divided up the assignment into parts and asked each of his team members to do a small part according to what he thought they could do best. He*

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<sup>3</sup> Sinhala and Tamil are the two national languages of Sri Lanka. Sinhala is spoken by the majority Sinhalese population. The secondary school curriculum is usually taught in one of the national languages. A pilot program commenced in 2002 to introduce English medium instruction to some schools in the early years of secondary education extending up to G.C.E. 'O' Level and up to G.C.E. 'A' Level for Science subjects by 2007 Ministry of Education & Higher Education, I., Battaramulla 2004, 'Recent Developments in Education in Sri Lanka', Accessed: 06 Sept 2006 at <http://www.moe.gov.lk/modules.php?name=Content&pa=showpage&pid=6#s223..> However the current intake at tertiary level were taught in a national language.

<sup>4</sup> In response to a Student Course Experience Questionnaire administered in 2006, some 60% of students indicated that they had followed short courses in computing after school. These were usually introductory Microsoft Office or programming courses. Less than 10% reported that they had had any exposure to computers at school.

<sup>5</sup> Lecturers estimate that some 30% of students are fluent in English, around 30% have very limited fluency and the rest are somewhere in between (Withanage, D. K. 2004, pers. Comm., May 11)

*thought they were fairly happy with him as a team leader because he always took on the biggest load himself. However, on top of that, he had to spend a lot of time chasing them up to make sure they'd get their assigned task ready on time. But no matter how often he reminded them there always seemed to be a big rush on the last day. Sometimes they didn't quite make the deadline. Then it was always a matter of rushing to start the next assignment.*

*The practical subjects were the best. Some subjects were very difficult to understand and seemed to be only theory, theory and more theory. To understand the lecture he often had to spend a long time with his notes and a dictionary. But with the pressure of assignments there didn't seem to be any time even for that any more. He hoped that there would be enough time before the exam. Thank goodness for 'kuppi'<sup>6</sup>.*

Asanka's story is typical. Coming from a traditional teacher-centered learning environment where the language of instruction is *swabhasha* (mother tongue), students are suddenly challenged to take control of their own learning, to work in groups, in English, and to be active rather than passive learners. Without major changes in the school system, this discontinuity cannot be avoided. Local ICT employers are putting pressure on the faculty to graduate young professionals fluent in English with superior teamwork and problem-solving skills and the ability and readiness to take responsibility for their own professional development. The faculty has only three years to help their students make the transition.

To meet the challenge, the faculty is introducing of problem-based learning (PBL) into some of its courses. PBL has been used successfully overseas to prepare students for employment in a number of professional fields including engineering, education, management and, most notably, medicine. The approach is based on small group work, collaboration and discussion, whereby learners enhance their team work skills while building effective problem-solving approaches. In most instances where PBL has been used successfully, group facilitators have provided learners with support on learning skills and ensured that they are aware of, and increasingly in control of, their own cognitive processes. In this way, their skills as learners improve at the same time that they master their knowledge domain. As teamwork, problem-solving and self-study skills are all of immediate applicability in the IT industry, PBL would appear to be an ideal solution to the needs of the faculty.

However, much of the research on PBL has been conducted in western settings and it is by no means certain how well the collaborative, constructivist learning styles of PBL will translate to the Sri Lankan context. How will students who have been passive learners in a traditional academic environment focusing on content, take to solving "fuzzy" problems in a real world context? How well can students who have been highly successful in a competitive individualistic school culture, be expected to take on collaborative team roles? Can this approach accommodate national social harmony priorities such as encouraging Tamil and Sinhala students to work together? Will it be an extra burden to students who are essentially bilingual learners or an opportunity?

This paper describes a program of design-based research that is being undertaken in Moratuwa University – one of 13 public universities in Sri Lanka. Insofar as design-based research seeks to understand theories of education by looking at the outcome of applying a

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<sup>6</sup> The *kuppi* is a private tutorial session held by students for other students in their mother tongue.

particular theory(ies) to the design of learning environments in various contexts, this research seeks to further our understanding of PBL through its use in a non-western culture.

The first subject area in which PBL was implemented was Software Engineering. In an industry setting, software engineers are the problem solvers. They usually work in teams, often comprising both representatives of the business and the IT side of an organisation. Hence software engineers need to be effective team leaders, excellent communicators, and, of course, good problem solvers. This seemed like an appropriate place to introduce PBL.

## **1. Understanding the Context**

Prior to introducing PBL, we set about to build an understanding of the context. We did this by asking students studying Software Engineering in 2003 to fill in a course experience questionnaires and attend focus groups. Three focus groups were conducted separately in English, Sinhala and Tamil and involved 24 of 50 students<sup>7</sup>. We subsequently interviewed the academic staff of the faculty. The following profile of the students and their learning environment is derived from an analysis of same.

### **1.1. Basic Demographics**

The student population is approximately 15% Tamil, 5% Muslim, and 80% Sinhala. This reflects the breakdown in the population at large. Some 25% are female and 75% male. Many of them come from rural areas and attended single-sex schools.

### **1.2. Objectivist Learning Environment**

Our initial research confirmed for us that the learning experience of our students through their primary and secondary education had been very traditional and academic with teachers largely adopting a behaviourist teaching style.

The following is a typical student comment,

‘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’ (Student, Focus Group 2003).

Unfortunately their experience once at university was little different as reflected in this comment on the 2003 Software Engineering course,

‘What we did 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 just memorise the theories, and just did the exam and forgot it. But those who worked in the Business Environment say if you have a good knowledge about that subject it’s really useful’ (Student, Focus Group 2004).

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<sup>7</sup> Variants of the Student Course Experience Questionnaire have subsequently been administered to 50 students in 2004 and 105 students in 2006. In 2004 and 2006 focus group sessions were repeated and involved 24 students in each year.

In emphasising the transmission of knowledge (Bichelmeyer & Hsu 1999, p73), the behaviourist mode of instruction often fails to develop the higher order learning skills essential for successful problem-based learning. Suspecting that this might be the case in the current context, we asked students to complete an in-class exercise that required them to research material on the Internet and apply it to a case study analysis. They found this task exceptionally difficult.

‘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’ (Student, Focus Group 2003).

However it is encouraging that students claim to reject the didactic approach - particularly the over-emphasis on memorising.

‘All this time memorizing like parrots has been futile’ (Student, Focus Group 2003).

### ***1.3. Use of Lectures***

A number of studies have pointed to limitations in the use of lectures to promote robust student learning (Carr, Locatis et al. 1999; Reid 1999; van Berkel & Schmidt 2001; Saunders & Klemming 2003). However, within the university system in Sri Lanka, the lecture is the accepted means of communicating knowledge to students albeit often supplemented with laboratory sessions.

Gunawardena (1998) explains the situation in this way,

‘...India 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’ (Gunawardena 1998, p105)

Students in the current study did, in fact, say that they appreciate lectures - but only where their lecturer is someone with industry experience who is able to interpret the course theory to them through the window of his/her own experience. This can probably be explained by the fact that the students, by and large, have little experience of IT before entering the faculty and are often from rural areas where their exposure to the software industry is minimal. They are therefore eager to gain insights into this world. Further, as is explained below, the group of students involved in this study tend to have learning styles which orientate to concrete experience and the real world.

It is government policy in Sri Lanka that university lectures should be given in English. This, and the length of the lectures (3 hours at the time of establishing baseline data), are an important dimension of the problem. The English language requirement has a ‘social harmony’ rationale in a country where a bloody civil war on ethnic lines has been going on for 18 years and is also designed to make graduates competitive in the business arena where many corporations have links to overseas offices and conduct the core of their business in English. However students who have attended government schools (the majority of those in the public universities) have been schooled in *swabhasha* and, for them, English is a second language in which many have limited fluency. Students in the initial English-medium focus group, estimated that their classmates generally understood only between 50-70% of the English in lectures and less towards the end of long lectures<sup>8</sup>. 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, p144).

The problem of limited English language fluency is gradually being resolved with the phased reintroduction of English-medium education to government schools in recent times (Ministry of Education & Higher Education 2004) but is still an issue for today’s university students. In the meantime, lecturers 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 examinations or vivas.

One interesting student strategy for coping with this situation is the *Kuppi*. The *Kuppi* is a small group tutoring session conducted in Sinhala or Tamil and led by a capable student from the same year or batch. 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).

#### 1.4. Societal Culture v’s Organisational Culture

The *Kuppi* culture is difficult to explain in light of the organisational culture of the Sri Lankan school system which prizes individualism and competitiveness. However reference can be made to the Hofstede profile<sup>9</sup> for Sri Lanka. The table below shows this contrasted with the profile for India and the world generally. Source:(ITIM)

	Sri Lanka	India	World Average
PDI – Power Distance Index	80	77	56.5
IDV – Individualism	38	48	64
MAS – Masculinity	10	56	51
UAI – Uncertainty Avoidance Index	42	40	65
LTO – Long Term Orientation	42	61	48

Table 1. Country Profiles derived from the (ITIM) web site

<sup>8</sup> 2003 Student Focus Groups.

<sup>9</sup> Geert Hofstede, studying IBM employees in 53 countries between 1978 and 1983, formulated a theory that world cultures vary along consistent, fundamental dimensions including 1) Power Distance, 2) Individualism, 3) Masculinity and 4) Uncertainty Avoidance.

This profile suggests that Sri Lankan culture is highly collectivist<sup>10</sup>. This, considered against the individualistic organizational culture of the education system, suggests that there is a conflict between school culture and social culture.

There is some evidence that Sri Lankans may exhibit a high level of individualism in the workplace, but still display a collectivism nature in family and social settings (Chandrakumara & Sparrow 2004). Chandrakumara and Sparrow attributed the anomaly of an individualistic culture dominating the workplace to the adoption of western business practices, however it is also possible that individualism in the workplace is merely an extension of individualism in the school system.

If students do, in fact, live comfortably with both cultures, it may be possible to build a better environment for the implementation of PBL simply by promoting the social collectivist culture within the learning environment.

## **2. Designing an Intervention to the Context**

The course was primarily designed to promote the sorts of skills commonly associated with problem-based learning i.e. to improve problem-solving skills, promote collaborative learning styles and teamwork skills, develop higher order thinking skills and give students the confidence and the skills to learn by themselves. In addition to this, there were other matters to be considered – notably English language fluency and social harmony issues. This paper will look at how we designed the course to promote independent learning (Section 2.2), problem solving skills (Section 2.5), teamwork (Section 2.3) and collaborative learning (Section 2.3) within the constraints of the existing environment.

### **2.1.1. Research Constraints**

There were a number of constraints that impacted on the research :

1. The weekly lecture was not negotiable – although, based on our initial findings, lecture times were halved from 3 hours to 1.5 hours.
2. Enrolments doubled in the second year of this study from 50 per batch or year group to more than 100. This increase was imposed on the university by the University Grants Commission. At the same time, the undergraduate section of the faculty moved back to the main campus at Moratuwa even though the new faculty building was only in the early stages of construction. The lower staff-student ratio and lack of tutorial rooms made it impossible to continue the small group sessions that had been facilitated by the lecturing team in the first year of research.

### **2.2. Independent Learning Skills**

The IT industry is characterised by rapid change necessitating constant retraining of its employees. In a recent survey, ICT employers in Sri Lanka listed a “Willingness to embrace change and to engage in incremental improvement to keep up with the rapid changes in technology” within the top ten skills they required of new employees (Madurapperuma & Macan Markar 2006). Although the industry provides training opportunities for employees, the ability to learn independently is a key requirement. Alarming, only 33% of second year

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<sup>10</sup> In a collectivist culture, individuals place group goals and group harmony above their personal goals and needs and are integrated into strong cohesive groups.

students said that they felt confident that they could learn a computer application without a formal course (Student Course Experience Questionnaire 2006).

Throughout the course, we presented students with a range of study tools in the expectation that they would see the value of these tools and be able to apply similar approaches to their learning elsewhere. Multiple choice quizzes were made available online for the content covered in each lecture and, in a tutorial session immediately before the mid-semester examination, students were asked to create quizzes themselves which were then put on the course content management system (CMS) to be used by other students. It was explained to them that making up questions was a good way to interact with the subject matter and hence a good study technique. In lecture sessions, student teams were asked to make up questions for other teams. Prior to the final examination, students were provided with past exam papers which they were asked to discuss as a group. Finally, lecture notes were made available on the CMS with recorded voiceovers so that students could repeat listening to the lecture as many times as desired.

In the first research cycle, a tutorial session was conducted on study skills. In the second cycle, students were introduced to concept maps as a tool to help them prepare for the final assignment. At the time, lecturers discussed with them the benefit of using concept maps to summarise lectures or sections of the textbook.

### **2.2.1. Theory Informing the Design**

In the 70s and 80s, extensive research was conducted on Cognitive Strategies (Rosenshine 1997). This work developed a range of heuristics to support student study, problem solving, reading comprehension and other forms of learning. Examples included summarization techniques, generating "who", "where" and "what" questions to improve reading comprehension, making links while reading with one's prior knowledge (elaboration), identifying key words, repetition, selection and note taking, and paraphrasing (Rosenshine 1997; Cartier, Plante et al. 2001). More recently, strategies such as concept mapping have been used to encourage deep processing of information rather than surface learning (Jonassen & Marra 1994; Reid 1999).

Hadwin (1996) stresses the importance of teaching such learning strategies in context and this was the intent of the current course.

‘When courses and programs attempt to teach students the tactics and strategies required for self-regulation outside meaningful course content, the transferability and strategic use of these tactics is jeopardized’ (Hadwin 1996, p2).

It was evident from their responses in focus groups that, despite a lifetime of academic study, the students involved in the study still needed to develop self-study skills. The study skills taught to them during their schooling and at the tutorials encourage teacher dependency and memorisation. Students spend these 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.

Despite this, many claim to be ready to take control over their own learning.

‘There is one thing. If the basic knowledge is provided by the institute that we learn the techniques won't change most of the time. The cover on the top

is what changes. If you know the concepts you can go ahead without a doubt, so there should be a technique like PBL, for us to find the path and go ahead. They don't have to teach us everything. If we know how to learn then there is no problem at all' (Student, Focus Group 2004).

### 2.2.2. Student Response

Unfortunately, students generally felt the study aids/pointers provided in the course to be far less useful than having time to study by themselves or to attend *kuppi* conducted by their peers. The only aid that they reported to be of any use was the recorded lecture notes with voiceover. However many also felt that this tool was less useful than it might have been because of the volume of slides included for each lecture and the level of language used in the slides.

This was consistent with the main criticisms of the course - that lectures needed to be made more practical or concrete, with real life examples used to explain concepts. Students felt that too much new material was introduced too quickly. They didn't understand the lecture content and could not see how what they were learning might be relevant to them.

It is likely that students' feelings of frustration about their inability to comprehend the course content extended to a rejection of the learning aids provided. Naturally a quiz which tests material that is incomprehensible to the user is of little use to him/her. Similarly, being asked to make up quizzes for material that is little understood, is likely to be regarded as a futile exercise. Some students felt that having team quizzes in lecture time was a useful tool. An equal number completely rejected them.

### 2.2.3. Discussion

The consistency with which the students rejected the course as being too theoretical and too rushed strongly suggests that we are dealing with a highly uniform population of learners with a concrete and probably sequential learning style for whom the format of the course was ill-suited.

This is not surprising given the background of this particular student population. David Kolb, the author of Experiential Learning Theory and the Learning Styles model derived from it, claimed that 'patterns of behaviour associated with the four basic learning styles are shaped by transactions between people and their environment at five different levels— personality, educational specialization, professional career, current job role, and adaptive competencies' Kolb 1984 cited in (Kolb & Kolb 2005). Kolb found that people with an educational specialisation of engineering or medicine and a professional career in engineering, medicine or technology tend to have a converging learning style (Kolb & Kolb 2005). Based on the fact that 65% of the students enrolling in the Faculty claim that they did so only after having been rejected for Engineering courses<sup>11</sup> (with a further 16% having medicine as their first preference and the remainder selecting IT as their first preference), it is entirely possible that we are looking at a group where the majority have a converging learning style.

Kolb describes the learning needs of converging learners thus,

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<sup>11</sup> Student Course Experience Questionnaire 2006

‘An individual with a converging style has AC<sup>12</sup> and AE<sup>13</sup> as dominant learning abilities. People with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. Individuals with a converging learning style prefer to deal with technical tasks and problems rather than with social issues and interpersonal issues. These learning skills are important for effectiveness in specialist and technology careers. In formal learning situations, people with this style prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications’ (Kolb & Kolb 2005, p5).

If we are correct in our assessment of student learning styles (and this will need to be tested in future iterations of the course), this analysis bodes well for the application of problem-based learning.

Kolb’s “converging” learning style corresponds to the “extraverted thinking” type under the Myers-Briggs Personality Type Indicator (MBTI) (Kolb & Kolb 2005, p6). According to Hills (2003, p123), the extraverted-sensory-thinking-judgemental type constitutes 11.3% of males in UK and US populations and the introverted-sensory-thinking-judgemental types constitutes 17.5% of males. Much of the feedback from students suggests that they are one of these two types.

A majority expressed the need for concrete examples to illustrate the theory. Some requested practical lab sessions.

‘Always when you teach you better give a real world experience. Through that you should teach the theory’ (Student Course Experience Questionnaire 2006).

According to Hills (2003) this reflects a preferred “sensing” function. He suggests that people with a dominant Myers-Briggs “sensing” function need to collect data from the real world; extroverts of this type in fact prefer to totally immerse themselves in the real world (Hills 2003, p132). Such people understand new concepts better if they are introduced through a real world example .

This need for contact with the real world is consistent with student feedback. In responding to the student course experience questionnaire, a majority felt that the course assignments were good learning tools as they were practical. Although the second assignment, which required them to apply their knowledge and information collected from a real world client to producing an industry document, was felt to be very challenging, they appreciated it because it was real to them.

‘When I heard about this [ the final assignment ] I was very happy because we can practice our theoretical knowledge with this. From this we can also gain some knowledge how to write a SRS in a proper way’ (Student Reflections, 2006).

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<sup>12</sup> Abstract Conceptualisation

<sup>13</sup> Active Experimentation

There were a number of requests for more order and structure in the course which Hills (2003, p132) claims is consistent with a “thinking” and “judging” type. Students frequently complained that they didn’t know precisely what was expected of them when doing assignments<sup>14</sup>. Assessment rubrics were provided for all assignments, and industry templates for the documentation to be produced in the final assignment. However students wanted more guidance – preferably an example to follow.

Learners with a Myers-Briggs “extrovert” orientation are likely to be successful team leaders because of their need to organise and help others (Hills 2003, p135) and there was evidence of this in student feedback.

‘From my point of view [the team leader] helping me at that difficult time period was showing the true team spirit and the correct leadership. It was really a great feeling when you get help from your team members at the troubled waters. This is just a one example on how our team is functioning’ (Student Reflections, 2006).

However some student responses suggest that they may be introverts rather than extroverts. Hills (2003) explains that although introverts generally prefer studying by themselves, they do need others even if only as ‘a sounding board for ideas and concepts, or a source of motivation and guidance’ (Hills 2003, p129). However, he goes on to say that, ‘there are also those Introverts who have little need for others in the learning process; their sounding board is the application of objective logic, and motivation comes from within’ (Hills 2003, p129).

The fact that students overwhelmingly considered “self-study”<sup>15</sup> as the most useful learning tool for the course is consistent with an introvert orientation. Many felt that teamwork was useful, however their comments did sometimes reflect a need for others to act as a sounding board,

‘Yes. When I’m typing something I would ask my members how if it is like; is this can be changed. ....Though they are assigned for a particular work, you can get the idea of the other person’ (Student, Focus Group 2004).

and sometimes indicated a lack of a need for others altogether.

‘Most of our guys take the team work not as an opportunity but as a nuisance. Most of the people like to do their studies on their own and get ready for the exams’ (Student Reflections 2006).

#### **2.2.4. Future Directions**

While it will be informative to test the learning style of students the next time the course is taught, the overwhelming similarity of student responses, already suggest a number of changes that can be made to adapt the course to match the learning needs of the majority.

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<sup>14</sup> Student Course Experience Questionnaire 2006

<sup>15</sup> Student Course Experience Questionnaire 2006

This is important since, with the current course format, students have rejected learning tools that might otherwise prove useful to them in improving their independent learning skills.

Consequently the next cycle of intervention will endeavour to,

1. Reduce the breadth of content to be covered in lectures to allow important concepts to be introduced through practical and real-life examples;
2. Provide more structure for students particularly in the orientation to assignments;
3. In the absence of lecturer-facilitated small group sessions, implement discussion forums to scaffold challenging assignments requiring higher level learning skills.

### **2.3. Teamwork and Collaborative Learning**

Teamwork skills were an important priority for us – partly because of industry demand (Madurapperuma & Macan Markar, 2006) and partly because we hoped to be able to leverage the *Kuppi* culture to promote collaborative learning styles within teams. With national social harmony in mind, teams were formed which included a mix of Sinhala, Tamil and Muslim students. We also endeavoured to include girls in most teams since many of the students come from single-sex schools but will be expected to work in mixed teams in industry. A personality quiz was used to select team leaders in the first year but this was dropped in favour of lecturer selection in the second year as it was found to be an unreliable indicator<sup>16</sup>. Students were expected to work on all assignments as a team. A number of supportive tutorial sessions were run based on topics such as the meaning of teamwork, conflict resolution, and holding successful meetings.

The challenge was to move the students away from the “workgroup” style of interaction that they favoured where the assignment was divided up based on the pre-existing skills of team members solely for the sake of expediency and where the team leader planned and directed activity (and often did much of the work). Obviously this sort of approach, precludes any *guided stimulation* and *qualitative scaffolding* that undergird cognitive gains in peer learning (Salomon 1993) or the opportunity to ‘observe and internalize modelled processes’ (O'Donnell 1999, p224). Nor does it encourage the brainstorming, mutual support and exchange of skills that the ICT industry try to promote through teamwork.

#### **2.3.1. Theory Informing the Design**

Collaborative learning (CL) takes place when a small group of students work together to solve a problem. Dialog is thought to promote learning through giving students the opportunity to assimilate each other's knowledge and test their understanding of new concepts on each other (O'Donnell 1999, Berkowitz and Gibbs, 1983, Topping, 1998 #2). Proponents of collaborative learning claim that interacting in dyads or small groups of peers encourages cooperative rather than unilateral social exchanges and that these are needed to counter the learners' tendencies towards overly subjective assimilation of knowledge and overly docile imitative accommodation such as might happen in interactions with teachers (O'Donnell 1999, p37). These tendencies, of course, are likely to be particularly pertinent in a society characterized by a high power distance.

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<sup>16</sup> Because they knew that the results of the questionnaire were going to be made know to their lecturers, the students tended to answer it in the way that they wished to be seen rather than as a true reflection of self.

‘Learners must think critically and creatively but also work collaboratively. Meaningful and worthwhile learning is best achieved in collaborative settings where students' misconceptions are revealed through discourse. Individual responsibility and control along with authentic communication is the essence of a constructivist approach to learning. The ultimate goal is to have students learn how to learn and become continuous learners’ (Garrison 1997, p6).

Topping (1998), in reviewing the research done to date on collaborative learning, states that the studies that have been done ‘indicate that CL typically produces higher levels of academic achievement, improved interpersonal relationships among students, and greater personal and social development than either competitive or individualistic instructional conditions’ (Topping 1998, p48). Specifically, he notes findings by Johnson and Johnson (1994) that the use of collaborative learning, ‘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’ (Topping 1998, p38).

The students already engage in a form of collaborative learning or peer tutoring – the *Kuppi*. The epistemological basis of peer tutoring, like collaborative learning, is constructivism. However proponents tend to take guidance from Vygotsky’s work in assuming that students will do better working with a tutor who is more competent than themselves rather than with a peer at the same level. "...the key mechanism (is) supported (or scaffolded) exploration through social and cognitive interaction with a more experienced peer, in relation to a task of a level of difficulty within the tutee's *zone of proximal development*<sup>17</sup>" (Topping 1998, p12).

‘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, p37).

In a peer-tutoring relationship the tutor stands to gain as much as the tutee since, as anyone who has taught will testify, the best way to learn something is to have to teach it to someone else. Locatis (1999) looked at situations where peer-tutoring relationships were set up between high-achievers and less capable students. He concluded that the high achievers benefit because in the process of explaining what they have learnt they are forced to elaborate the content helping them to build new knowledge constructs. Low achievers benefit from having another learning resource.

‘Since higher achievers have recently learned the material, they can provide explanations based on the mental elaborations and relationships that they

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<sup>17</sup> Vygotsky’s “zone of proximal development” is defined as what a student is capable of with the aid of a more competent other O'Donnell, A. M. 1999, *Cognitive Perspectives on Peer Learning: Rutgers Invitational Symposium on Education Series*. Lawrence Erlbaum Associates Inc. Mahwah, N.

used in learning. These explanations can be more meaningful to their cohorts than those that teachers offer. Since teachers have internalized and compiled content, they often are no longer conscious of the intervening concepts that they generated to mediate their initial learning' (Locatis 1999, p23).

Despite the popularity of the *Kuppi* as a form of peer tutoring, we had some doubts that true collaborative learning would take place in the current context given that the “workgroup” approach is more the norm for group work and generally the role model to which the students are exposed in the culture. This approach is also consistent with the competitive and individualistic approach to learning that the students have been exposed to throughout their academic careers as it essentially allows them to continue working individually and presents itself as the most efficient way to ensure high marks within the available timeframe and with the given resources.

At the same time we wondered whether true collaboration could take place in the effective absence of a common language. Not only did the language issue make communication difficult, it also meant that some people found it much easier to grasp the subject matter and read the materials than others simply because they had a better command of English.

Given that we were attempting to effect a culture change of sorts, it seemed advisable to go beyond merely creating an opportunity for collaborative learning. Instead, we thought to take direction from the field of change management and adopted a mixture of an “empirical-rational” approach and a “power-coercive” approach Bennis, Benne & Chin cited in (Nikols 2004). Appealing to reason, we showed students the results of a survey of ICT employers we had conducted in 2004/5 (Madurapperuma & Macan Markar 2006) and videos of CEOs of well known software development houses talking about the importance of soft skills including teamwork and communication skills.

As part of our “power-coercive” strategy, we took on board research that indicated that “...the greatest achievement effects [for team work] occur when there are group goals with individual accountability” (Locatis 1999) and introduced peer assessment and vivas<sup>18</sup> for individual team members. We had some doubts as to whether peer assessment would be successful since research suggests that in a collectivist culture the norm is for equality of reward distribution among peers (Dimmockk 2000 #7, ITIM online) however the approach has been used successfully in Singapore (Chew, 2005), another Asian culture and, if successful, would certainly generate the desired individual accountability.

Assuming that collaborative learning and good teamwork strategies would be generated in the devised learning environment, we then wanted to ensure that our students would internalise those skills into their learning repertoires by asking them to reflect on their teamwork experiences. Reflection is an essential part of the constructivist learning cycle

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<sup>18</sup> Peer assessment in this case refers to students allocating marks to their fellow team members to indicate the extent of their contribution to the team product. In the viva or oral exam individual team members can be questioned on any and all aspects of their team product; this is to discourage the common approach to group work whereby individual components of the assignment are allocated to team members without any group input or discussion.

(Jonassen 1998; Bichelmeyer & Hsu 1999) and consistent with the Kolb Experiential Learning Model (Atherton 2002).

### **2.3.2. Student Response**

The results to date indicate some early successes which need to be reinforced further in subsequent curriculum units. While students appear to be convinced about the importance of soft skills, they have not, by and large, been exposed to enough success experiences in working with their teams to effect lasting behavioural change in their approach to team work.

The videoed presentations by industry leaders were well received.

‘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 professional. Most of those mentioned skills were new to me. Because I didn't think that these are that much interesting’ (Student Course Experience Questionnaire 2006).

However most teams still reported that they approached assignments as a workgroup rather than as a team. Team leaders were seen as having responsibility for getting the assignment in on time and allocating tasks to those team members most capable of, and willing to help.

‘If one knows English well, then we give the writing part to her. Madam thought that each person will do separate work [i.e. each prepare their own section of the presentation with help from others]. If we did it that way the quality of the project decreases. It's better to use specializations skills of a person. The team leader must know to manage and give which is relevant to whom in his area of capability’ (Student, Focus Group 2004).

Where some members of the team are seen as less capable, they are either not given any tasks or they themselves opt out of contributing to either discussions or work. This is not surprising in such a competitive academic culture but a serious obstacle to realising the potential for collaborative learning nonetheless.

‘Though few were committed it is rather embarrassing to mention that some group mates neglected their responsibility and made the live 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 Reflections 2006).

It should be noted, however, that after two semesters of team work, some students were starting to recognise the limitations of this approach,

‘The leader is saying you do this and that, and may be he is giving the easy parts to others, like he is not allowing others to learn something out of the assignment. And he's getting the cream out of that. That's not good’ (Student, Focus Group 2004).

Moreover there was some evidence of collaboration and brainstorming and even more of peer tutoring,

‘When we were developing our team web site, all the members shared their knowledge with other members. When some one has done something others don’t know, this member taught that particular thing to others’ (Student Reflections 2006).

Peer tutoring was particularly evident with the first assignment which required students to build a team web site. Many people had good technical skills from their first year Web Technologies course and were able to help others to build the site. There was however far less cooperation evident in the second assignment which was heavily weighted towards reading and writing and required a good command of English both to understand the support documentation and to complete the written assignment.

Certainly team work is a new experience for these students and it is unrealistic to expect behavioural change to occur rapidly. In addition, the lack of a common language is a significant obstacle as this comment from a Sinhala-medium focus group shows.

‘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’ (Student, Focus Group 2004).

This is consistent with international findings. In her work at the University of Hull, Cammish (1997) also found that bilingual learners ‘may experience problems when they have to interact orally as for example in small group sessions’ (Cammish 1997, p144).

However there appeared to be a number of other factors at work. Firstly students reported that they were overwhelmed by the volume of work expected of them. Even when the number of assignments and the volume of tutorial readings were cut back substantially in the second year, 85% of students said that they thought the workload was too heavy and 83% said that because there was so much work in the subject, it was difficult to understand it all (Student Course Experience Questionnaire 2006). While two assignments, neither of which required independent research, and weekly tutorials with readings and exercises to be done in class time would not normally be perceived to be a heavy work load at tertiary level, it must be remembered that many students in this context are struggling to learn the language as well as the content. It is likely that this perception of working under pressure would encourage students to get assignments done in the most time efficient manner and discourage group discussion.

Secondly, there is variable support within the student population for the mechanism of peer assessment. In the first year this approach was used, the percentage variation in peer assessment scores within a group ranged from 0% to 35% with an average of 13%. At that time students said that they didn’t really know how the peer assessment marks were used or even if they were really used, with the result that giving low marks to team mates to admonish them for lack of commitment had no deterrent value. In the second year, an explanation of how peer assessment marks were used to weight team marks was posted on the content management system as were team and individual marks. However, In the final assignment of the second year the percentage variation in peer assessment scores within a

group ranged from 0% to 28% with an average of 10%. The explanation, in the words of one student,

‘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 2 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’ (Student, Focus Group 2004).

Our experience of using individual vivas or oral exams to promote individual accountability was similarly unsuccessful and had the added complication that, as the vivas were conducted in English, it was sometimes difficult to know whether students inability to talk about the details of the assignment was due to the fact that they had had limited involvement in producing it or merely because they couldn’t express themselves in English. In some cases, fellow students had to be called upon to translate the responses of their peers. Viva grades had only a 0.304 correlation with peer assessment grades. Team spirit was evident, however, in the number of students who came in to do their vivas having been “tutored” by their fellow team members in the sort of questions to expect. Unfortunately, in many cases, answers had been memorized and were given regardless of the questions asked.

### 2.3.3. Discussion

Good teamwork skills are starting to emerge and peer tutoring occurs but there is limited evidence of collaborative learning to date. Those students who did describe positive experiences with collaborative learning activities such as brainstorming or group discussions, will probably be prepared to commit the time and energy to repeat these in the future. The problem appears to be that, for many, these positive experiences were lacking or overshadowed by negative teamwork experiences.

It would appear that the language barrier is a major issue, precluding meaningful dialogue and resulting in some students being shut out from the team. This was particularly evident in the second assignment which required the production of a written report.

The situation was not helped by a reluctance on the part of most students to make their classmates accountable for their group work contributions. Between students not being asked to contribute because they were not perceived as capable, and students failing to contribute because there was no deterrent to not doing so, assignments often ended up being done by two or three people with the others missing out on the learning experience.

Finally the heavy subject work load has meant that students have failed to have time for dialogue, to catch up on lectures or even for team bonding. Some report that they have not had time to organise or even attend a *Kuppi*. If this is true, it would seem that in trying, unsuccessfully, to promote collaborative learning in the formal teaching-learning environment, we have managed to stifle informal collaborative learning.

### 2.3.4. Future Directions

To avoid a repetition of these problems, the next cycle of intervention will endeavour to,

1. Reduce the course work load largely by reducing expectations about what soft skills can be covered. Given the constraints of the teaching-learning environment in this context, it is not reasonable to expect to achieve significant change in a one semester course. For PBL to be successful in this context it will need to be introduced by small

increments, across the curriculum. To test this, we will expand the base for intervention to include a first year subject.

2. Allow students to choose their own groups for teamwork assignments. This is almost certain to result in separate Sinhala-medium and Tamil-medium groups where there will be no language barrier to collaboration. This is only a stop-gap solution with the short term objective of giving students an experience of collaboration that they can take with them to other learning situations. It is also important to put more resources into working with students to improve their English with the long term goal of achieving collaborative learning situations based on dialogue in English.
3. Design assignments to have a significant practical component as well as a written component so that all members of the team can contribute.
4. Find another way to ensure individual accountability. One possibility is to ask all members of a team to state in writing the contribution they have made to the assignment – a statement to be signed and verified by fellow team members.

#### ***2.4. Communication Skills / English Language Skills***

Problems associated with limited English language fluency are a recurring theme of this study. Poor English skills are an impediment to independent learning and collaborative teamwork.

‘Software engineering is not easy for us to learn alone. We don’t know anything. We don’t understand what we read’ (Student, Focus Group 2004).

Additionally, students who are trying to learn the language at the same time as the content of a course, tend to become overwhelmed by the scale of the challenge they face.

##### **2.4.1. Theory Informing Design**

Given that the language of instruction, English, is not negotiable, support needs to be provided to the students as bilingual learners to improve their Cognitive Academic Language Proficiency (CALP). Some support has been provided in these first two cycles of intervention through providing an online copy of the lecture with a voiceover which allows students to become familiar with pronunciation and develop a feel for the rhythm and intonation of English sentences. The provision of pre-printed lecture notes also allows them to concentrate on the lecture rather than taking notes. It is difficult for bilingual learners to paraphrase in their second language in order to take notes and the other alternative, continually translating back to mother tongue, is likely to be challenging when new concepts are encountered. Some effort is also made to explain difficult words in the lecture.

##### **2.4.2. Student Response**

As stated above, students have found that the pressure of work has made it difficult to find time to use one of their main strategies for coping with a second language learning environment, the *Kuppi*. This is regrettable and solutions need to be found. However, attending a *Kuppi* does not help students to become more fluent in English. Tools that promote fluency in the English of the discipline, need to become a focus of the course design.

Means need to be found to expose students to, and encourage them to use, spoken English. The lecture with voiceover was a start but as it was recorded as a single Flash™ presentation, the user could not control it – even to go forward or backwards as desired. A more interactive tool needs to be found.

Students tended to appreciate their vivas as it gave them an opportunity to use English in an interview situation which they could see as directly relevant to their future lives.

‘I was unable to speak in English with some one until this VIVA, so I was satisfied a lot about my speaking’ (Student Reflections 2006).

Likewise, group presentations were viewed favourably since presentations to clients are likely to be required in industry.

Ironically, one of the solutions posited in the previous section – that of allowing students to choose their own teams to promote collaborative learning – is likely to reduce student exposure to spoken English as it is only in mixed language group meetings that they use English.

### **2.4.3. Future Directions**

Given the impact that lack of English fluency appears to have on the learning environment, more needs to be done to support student bilingual learning. Fortunately the CMS selected, Moodle™, was designed as a constructive learning tool and has a lot of potential to achieve this.

As the language and format of the course textbook seems to be beyond the level of comprehension of many of the students, a good starting point might be the use of the Moodle™ “lesson” module to present important sections of content in a more comprehensible format but one which nonetheless exposes the reader to important technical terms and at the same time expands their vocabulary of important but low-frequency non-technical English words. Moodle “lessons” have test questions which the student has to answer at the end of each section or page in order to proceed to the next page. These questions can be used to practice new vocabulary or to draw connections between the material being presented and other lectures or courses. Moodle™ also provides a “glossary” module which could be used to build an electronic version of a bilingual language learner's English-only dictionary. This would include word sound files, examples of use, examples of related ways in which the word can be encountered etc. Coelho (2004, p224) suggests that ‘words that are important to understanding a specific concept or lesson are best taught in the academic context in which they occur’. Taking this on board, the intent would be to build a comprehensive tool to support the learner in the immediate context whilst building his/her subject related fluency which would, in turn, provide access to other texts and resources.

Using Moodle’s “Drag-and-Drop” module<sup>19</sup>, it would also be possible to summarise each lesson with a concept map to which selected labels can be added by drag-and-drop. This will not only make the underlying organization of ideas in the lesson apparent to students, but would also show them how to study by modelling how to use key words and phrases to summarise rather than copying word-for-word from the text as many currently tend to do due to their lack of confidence in the language.

### **2.5. Problem solving and exercising Higher Order Skills**

Software engineers are problem-solvers. The process of problem solving is something that FIT students need to master. Consequently, we undertook to give them an orientation to Problem Based Learning (PBL) in general and the problem solving process in particular. We

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<sup>19</sup> This module allows labels to be dragged onto an appropriate graphic but rejects an incorrect allocation.

followed this up by asking them to solve their own PBL problem - one which they are likely to be faced with when they join the workforce. This involved writing a Software Requirement Specification (SRS) based on client specifications.

### **2.5.1. Theory Informing Design**

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 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. Polanco, Calderon and Delgado (2001) claim that this failure to recognise 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' (Polanco, Calderon et al. 2001, p4). Lohman (2001) claims that, unlike more structured methods of exposing students to problem-solving such as the case study, the PBL approach results in "double-loop learning" where the learners develop schemata for problem solving that they can apply anywhere.

The challenge here was to allow the students to actively solve a problem for themselves while scaffolding the experience enough for them to make it a successful learning exercise. We anticipated that students whose academic experience to date was very content-heavy would find this exercise difficult and even, perhaps, resist it. Moreover their non-collaborative approach to group work did not give us any grounds for optimism since a collaborative approach is essential for effective team-based problem solving.

Accordingly we sought to scaffold the learning experience through the use of case studies.

(Jonassen 1998) suggests,

'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, p223).

### **2.5.2. Student Response**

In the first year, with lecturers acting as small group facilitators, the SRS exercise got a very good response.

'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' (Student, Focus Group 2004).

However in the second year, with no facilitation, students felt rather lost.

'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' (Student Course Experience Questionnaire 2006).

It should be noted that there was no opportunity to set up discussion lists or chat sessions between students, lecturers and the client in the second year since the university was unable to provide an Internet connection to the computer laboratory. Hence a number of forms of support that were enjoyed by the first group, were not available to the second. The second group of students also felt that the case studies they were presented with to scaffold the problem solving exercise were irrelevant – possibly because they did not directly model the production of a software requirement specification.

This result was Software Requirement Specifications being handed up marred by rampant plagiarism with whole sections of the assignment being copied from one group to another. Cammish (1997) noted a similar tendency to plagiarise amongst the international students at her university 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 was undoubtedly another contributor.

There was, furthermore, no evidence that students had attempted to apply the problem-solving process modelled in the tutorial, in tackling the assignment. The assignment was structured to comprise two deliverables with the first deliverable being a series of questions to be asked directly of the client after having read the background material. This assumed that students would discuss the problem amongst themselves and identify issues that required further research which they would then formulate into questions for the client. However at the client session there was little evidence that students had even read the background material.

### **2.5.3. Future Directions**

A number of studies (Fisher, Grasel et al. 2000; Pedersen & Liu 2001) mention the need for ‘strategy modelling’ to support student development of problem-solving skills. The student response described above suggests that this needs to be provided through a very structured, set assignment. In the absence of small group facilitators, full support including discussion forums and chat sessions with clients and lecturers should be used to walk the students through the process. Attention needs to be given to creating environments for collaboration.

## **3. In Summary**

This paper is based on design-based research framework intended to gain further insights into constructivist learning theory in general and problem-based learning methods in particular by looking at the outcome of applying these approaches in a non-western culture – in this case, Sri Lanka.

Surveys of local ICT employers referenced in the paper indicate that these employers are looking for potential employees with the sorts of soft skills nurtured by the PBL approach in western contexts suggesting that PBL may be an appropriate approach in the current context.

However several aspects of the learning environment in the public university system in Sri Lanka challenge some fundamental assumptions that are generally made about the environment in which PBL methods are deployed.

Constructivist learning environments such as PBL assume that there will be no communication barriers between team members and that teams are made up of people who accept each other as peers. While this is generally true in western environments it is not

necessarily the case here for a number of reasons. First and foremost is the language barrier. The university population does not effectively have a common language although the intent is that English will have that role. Secondly there is the competitive, results-orientated organisational culture which is a legacy of a highly selective education system. This in itself becomes a barrier to communication where less capable (or less fluent) students do not want (or are not invited) to contribute to discussions or group work because of a fear that they might lower the standard of the final product. Further there is some evidence that this same competitive education system has selected for introvert personalities who have limited use for collaborative learning and prefer to work alone.

Finally, there are few role models in Sri Lanka for the sort of collaborative working / learning environment assumed by constructivist educators. In academic circles, as in the work environment, more authoritarian, hierarchical structures tend to prevail. Accordingly student team leaders are expected, and expect, to take responsibility for group projects rather than the work being owned by the whole team. This is consistent with the culture which is characterised by a high power distance. Such factors mitigate against the opportunity for the sort of discussion where peers challenge each others' understanding leading to collaborative learning. However, with the right incentives, such an environment is conducive to peer tutoring and there is evidence of this taking place on both a formal and informal basis.

A number of suggestions have been made in this paper for ways in which limitations in the learning environment can be addressed and positive aspects, such as peer tutoring, reinforced. First and foremost, it is essential to recognise that the public university system in Sri Lanka is a bilingual learning environment and the teaching approach needs to be adapted to accommodate this. Secondly, it must be recognised that it is more important for students to learn how to learn than for them to cover content. It will be necessary to cut back on the theoretical content to be covered in courses in order to be able to spend more time on teaching the language of the discipline and the approaches and skills. Having said this, there are early indications that lecturers in the current context are fortunate in being faced with an unusually uniform population of learners such that it should be relatively easy to design an efficient and streamlined curriculum which does not need to concern itself with accommodating the diversity of learning approaches that normally confront lecturers in western institutions.

Lastly, and significantly, the recommended approaches can not be successful if they are only implemented in a single course unit. Changes in approach will need to be made throughout the curriculum to have any lasting impact.

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