Communication in a Problem Based Learning Environment: Supporting the Teaching Team in the School of Electrical Engineering

Juan Shi
Victoria University, Melbourne, Australia
Juan.Shi@vu.edu.au

Charles Mphande
Victoria University, Melbourne, Australia
Charles.Mphande@vu.edu.au

Alec Simcock
Victoria University, Melbourne, Australia
Alec.Simcock@vu.edu.au

Robert Ives
Victoria University, Melbourne, Australia
Robert.Ives@vu.edu.au

Paul Bronson
Victoria University, Melbourne, Australia
Paul.Bronson@vu.edu.au

Abstract: Problem based learning (PBL) has been introduced at Victoria University (VU) into its undergraduate engineering programs. PBL represents a radical change and requires substantial effort and commitment to adapt traditional practices in response to the challenges of PBL and related communication needs of a diverse student population. Furthermore, professional bodies, such as Engineers Australia, place increasing demands on communication as a crucial engineering graduate attribute.

In implementing PBL the delivery of both communication skills and professional skills has been integrated within the technical solution of the problem given. As a consequence there is a greater requirement for the supervisors from the electrical engineering staff to develop their skills in the teaching of language and communication. The linguistic diversity and varying English language proficiency levels of students in the electrical engineering course exacerbate the necessity for staff to familiarise with or upgrade their skills in language across the curriculum, and communication in general. Students in the electrical engineering program come from a wide range of socio-cultural, linguistic and educational backgrounds. Many have limited English language skills for their academic pursuits. In response to language and communication demands placed upon the Engineering staff in PBL, staff from the School of Communication Culture and Languages has been engaged to induct the Engineering staff in matters pertaining to the nature of language learning and language across the curriculum. Strong parallels between communicative approaches to language learning/teaching and the PBL approach were used as a starting point to develop an effective staff orientation program.

Introduction

The student population enrolled in the School of Electrical Engineering courses includes a wide range of socio-cultural, educational and linguistic backgrounds. Over the years, English language proficiency levels have been noted to crucially affect engineering students' academic success. Poor command of English, sometimes with an extremely poor ability in written English, is not uncommon. The seriousness of this matter is pronounced as engineering educators as well as professional engineering bodies now emphasise as essential attributes to an engineering graduate, not only lifelong learning but also "communication and teamwork skills and…[the ability to] appreciate the social and nontechnical influences on engineering solutions and quality processes" (Lattuca, Terenzini, Volkwein & Peterson, 2006). In Australia professional engineering courses are accredited by Engineers Australia. Engineers Australia (2005) specifies the following as essential attributes for engineering graduates: "good interpersonal and communication skills – both transmitting and receiving information; ability to interact with other disciplines and cultures; well-developed capacity for self-directed, lifelong learning." Such requirements from professional bodies require innovative responses from engineering staff, who traditionally have had little to do with issues of language and communication instruction. Previously, the School of Communication, Culture and Language at VU provided language and communication teaching to engineering students. However, in the PBL mode of learning/teaching, the engineers themselves need to assist learners not only with technical engineering knowledge and skills, but also in professional skills including language and communication. This paper focuses on a program conducted between staff from the School of Electrical Engineering and the School of Communication, Culture and Languages to develop the further integration of communication skills into the engineering curriculum, and to assist the staff in meeting the challenges presented by the introduction of PBL. It is hoped that skills gained from this program will not only lead to a better understanding of the language and communication problems faced by the students, but also inform remedial and other strategies. The paper highlights parallels between communicative language teaching, particularly learner autonomy, and problem based learning approaches. These are particularly useful to develop effective language across the curriculum and communication induction to empower academics who have little or no training in language and communication instruction.

Problem Focus Learning Features and Language Across the Curriculum (LAC)

To reinforce the centrality of communication to engineering graduates, the Engineering staff have taken it upon themselves to be role models in communication and linguistic competence for students. As language and communication comprise elements of integrated components of the PBL mode of learning, it is considered important that the students should see appropriate levels of expertise among staff , thereby dispelling the view that in an engineering course "communication or writing [are] skills set with a handmaiden's status" (Showm, Hirsch, Yarnoff & Anderson, 1999).

Language across the curriculum specialists consider that PBL with its focus on independent learning (Delisle, 1997), and the Communicative approaches to language learning/teaching,

especially strategies for learner autonomy, have many parallels (Richards & Renandya 2002; Wenden, 1991). According to Margetson (1994) PBL or Problem Focus Learning (PFL) has the following features.

Knowledge structuring
Whereas subject-based learning subjects are learned in isolation to be applied later, PFL areas of study are learned in relation to one another.

Learner activity & interaction with others
While subject-based lectures are lecturer-centred, PFL makes student participation typical. Interaction, dialogue, discussion and knowledge sharing are features that make PFL learner-centred/active.

Learner Motivation
Student participation is motivating in itself. Lecturer's questions are utilised to show students their inadequate or false views so as to find or understand and adopt *better* views. In addition, lecturers select and organize "problems" in a way to attract student interest.

LAC, learner activity and interaction in PBL

The Language for Specific Purpose (LSP) approach to language instruction shares fundamental principles of learning with PBL. In both LSP and PBL, language is tied to the needs of the learner and in both the teaching-learning environment simulates the employment destination (target) environment (see Kennedy & Bolitho, 1984; Munby, 1979). In keeping with curricular innovation (Markee, 1997), staff re-orientation in regards to beliefs about learning and instruction are important. A learner-centred approach has been adopted instead of a teacher-centred approach. A fundamental feature of PBL is learner self- or participant-directed study. In order to support this at VU we are developing the student's awareness of a related feature drawn from the learner autonomy language learning/teaching approach (see Wenden, 1999; Richards & Renandya, 2002). The students are given assistance through workshops to develop linguistic and communicative learner cognitive, affective, and self-management strategies. As a consequent of the recent introduction of PBL at VU it has been necessary to almost simultaneously conduct these workshops on two levels, firstly to educate staff and secondly students. The educational benefits of peer 'teaching' (student to student) to explain unfamiliar or difficult concepts (technical and/or language) are also enhanced by these workshops.

LAC and learner motivation in PBL

Language support courses in subject-based learning contexts are often beset by problems of student disinterest in 'irrelevant' language courses (Ballard & Clanchy, 1991). LSP practitioners often point to the fusion of language and specialist subject studies as a way of dealing with student lack of interest in language support courses. The LAC induction initiative is meant to provide the means to handle not only situations of learner indifference to language and communication in a PBL program, but also to provide remedial assistance.

Description of the Workshops

The LAC workshops that will run within the two semesters of the 2006 academic year are designed to serve two functions. One is for our LAC specialist to support staff to develop the necessary "language for learning". Thereafter staff will be able to facilitate student learning of science/engineering content using appropriate communication/language skills. The second is to provide staff with the necessary metalinguistic/metacognitive and diagnostic tools to allow them to be able to assist learners to manage the process of learning *how* to learn, especially describing their experiences – as an essential component of PBL. The support that is offered in LAC Workshops is crucial because metalanguage for describing learning experience being a step higher in abstraction adds to student language difficulties. The staff's position is important to facilitate student management of the total learning process. In addition, PBL is not a common learning tradition among most overseas students who come to VU.   Staff support to manage the change of learning culture is essential to avoid learner frustration and undue attrition. It should be pointed out also that by design the workshops are need driven, as a result of which there is flexibility in areas of focus (content).

Semester 1 Workshops for Staff

During semester 1 a series of workshops were conducted. The purpose of these workshops was to empower the electrical engineering staff with learning theory and metalanguage in language learning and learning strategies to enable them analyse and evaluate student reports and reflective writings included in their portfolios. As a result, the electrical engineering staff have demonstrated knowledge of and competency to identify the language and communication problems the students have with a view to address the problems students experience.

We provide below only topic descriptions of these workshops in the initial phase.

Workshop 1: The cultures of learning: variation of attitudes to knowledge, teaching and learning strategies.
Workshop 2: Knowledge about (language) learning: characteristics of meta-cognitive knowledge; kinds of meta-cognitive knowledge; learning styles – a glossary.
Workshop 3: Learning strategies: characteristics of (language) learning strategies; kinds of learning strategies.
Workshop 4: Learning culture influence on attitudes towards self-directed learning/learner autonomy.
Workshop 5: Identifying the issues in stages of teacher/learner in learning to learn.
Workshop 6: Writing Across the curriculum: Writing as tool for developing professional communication skills.
Workshop 7: PBL and LAC: Writing across the curriculum/Writing in Disciplines.
Workshop 8: Genre analysis: ideas for teaching varieties of writing.
Workshop 9: Developing language and communications assessment criteria (for evaluating student portfolios).

What Has Been Achieved in Semester 1

The workshops described in the above section were conducted by the language and communications specialist from the School of Communication Culture and Languages for a

total of five hours per week. The workshops stimulated interesting and rewarding discussions which yielded helpful insights in regards to teacher and learner roles in (language) learning, dealing with learner linguistic and learning cultural diversities, and language learning strategies in the PBL approach.

A review session was conducted after the workshop 5. During the review session, student reflective writings submitted for PBL were analysed with guidance from the language specialist, following approaches in genre analysis (see Swales, 1990; Bhatia, 1993). The participants analysed students learning styles and learning strategies. Students' concerns and problems have been identified and strategies to address their concerns and to assist the students to overcome their problems have been developed.

A few paragraphs of much longer texts from students' reflective written pieces that were analysed for metacognitive knowledge, metalanguage and attitudes towards self-/participant-directed learning during the review session are shown below. At this point the analysis did not focus on language problems *per se*; that was left for later workshops.

Student A:

Individual reflective statement

My life as a student in electrical engineering at Victoria University is a very demanding one because of many reasons, the first reason being is that I am living away from home so I need to be self dependent therefore I have the responsibility of taking care of myself like cooking, cleaning etc.

The next reason why I find studying electrical engineering demanding is because of PBL, I will be honest with you I love the practical side of PBL because I feel that a lot of universities just focus onto the theory and forget about the practical, but I find PBL challenging because of the reliance of the group what I mean is that if one person in the team is not doing what is required of them then we all fail the course.

Another challenge with PBL is that I am not very sure on what evidence I should present in my portfolio as a justification that I have learnt the required learning outcomes.

The elements I find enjoying in PBL is the group setting this includes discussing the problem, discuss methods to solve the problem, then eventually after finding the solution we get ready for the next problem or if we tried the agreed solution we discuss further or try the alternate solution.

Wenden (1991) categorises strategies into cognitive and self-management. She further asserts that to promote self-directed/autonomous (language) learning, learning strategies should be included as learner training content. The participant analyses showed consensus over several points that are noticeable from this portion. The participants pointed out that in the text there were indications that Student A was aware of self-management strategising. The student was aware that he needed to learn to manage time well as he has to fulfill more roles than he was used to doing before university studies. Another point the participants were able to notice was metacognitive knowledge operations. According to Flavell (1979) "metacognitive knowledge includes all facts learners acquire about their own cognitive processes as they are applied and used to gain knowledge and acquire skills in varied situations." Alberta Learning

(2004) elaborates that metacognitive knowledge has to do with knowledge of person, task and strategy; that is, knowledge: of one's capacity to learn, about the nature of what is to be learned and the actions one can take to aid one's thinking. In relation to Student A's text the participants were able to point out indications of operations of task knowledge as the student writes about task difficulty, "Another challenge with PBL is that I am not very sure on what evidence I should present in my portfolio as justification that I have learnt the required learning outcomes." This was a first step in the right direction to find out more about the task. A further point the participants picked out of the text pertains to attitudes towards participant-directed learning. Although on the balance, Student A seems to have developed a more positive than negative attitude towards self-/participant-directed learning, Student A showed some apprehension in regards to team work, as he points out "I find PBL challenging because of the reliance of the group what I mean is that if one person in the team is not doing what is required of them then we all fail the course." The participants were able to single out issues they may address with the groups represented by this student. From this reflective piece and others the team considered assisting students with social skills as a priority.

Another text analysis that participants felt yielded insights was Student B's reflective piece, whose excerpt is below.

Student B:

> It has been five week since I started this PBL course and so far it has been a pleasant experience. I think that it is a great approach to learning and I have enjoyed many aspects of Problem Based Learning up to now. One of the things that I like about PBL is that it forces you to work (or learn) by yourself. I personally like the idea that you have to decide for yourself what you think is important to learn and learn it. The supervisor is always there to make sure that you are on the right track and that you are not learning something that is irrelevant to the problem. Although I have enjoyed PBL thus far, I found it challenging at the beginning. The thing I found the most challenging about PBL was that it was not clear in my mind what was expected from me in the particular problem. I felt that there were not enough resources given to us at the time to solve the problem.

Student B showed another angle to student attitudes to participant-directed learning. Earlier in the text, Student B mentions that he considers himself "to be an independent learner" which in the analysis the participants agreed that by this the student indicated his learning style preference, namely individual major learning style preference (see Wenden, 1991) which he labeled "independent" learning.

In the excerpt, Student B's reflective piece added the dimension of stages in learning self-/participant-directed learning. According to Grow (1996) self-/participant-directed learning can be taught and as students have different abilities to be self directed, teachers need to adapt their methods in response. Grow (1996) has classified the stages as follows. Stage one is when learners have low self-direction. However, learners may be temporarily dependent in face of new topics, and for reasons of efficiency. Learners at stage two are classified as showing moderate self-direction. Learners at this stage are the generic 'good students'; they are confident but may be largely ignorant of the subject. At stage three learners are at intermediate self-direction. They see themselves as participants in their education and are ready to explore. They may benefit a lot from learning how they learn, for instance making conscious use of learning strategies. Learners at stage four are classified as learners of high

self-direction. They are said to be capable of setting their own goals and standards with or without help from experts.

As far as Student B was concerned, the participants were agreed that he was on the dependent end of the continuum, as he reflected "The thing I found the most challenging about PBL was that it was not clear in my mind what was expected from me in the particular problem. I felt that there were not enough resources given to us at the time to solve the problem." As well as showing to be teacher dependent, the text showed that the student lacked task knowledge (Wenden, 1991). In this regard the participants observed that there was need for the staff to be flexible in their roles. In the case of students that B exemplified, the coaching with immediate feedback or motivating/guiding roles may be beneficial to such learners (Grow, 1996). The insight from this analysis was that need to monitor carefully the various stages towards self-directed learning that the different students may be at so that appropriate assistance may be given. As PBL represents a radical shift, rigidly assuming the role of facilitator, which is appropriate for stage four learners, may be detrimental to many learners.

The third text participants analysed confirmed that, as in the case of Student A, Student C showed awareness of self-management skills, especially time management. Although the greater part of the text shows a motivated student, this excerpt shows admission of failure in time management: "I did not utilize my time very effectively as I had trouble meeting all the deadlines". This admission is a step in the direction of seeking alternatives. This is further confirmed in the text as Student C reflects, "I find circuit theory the most challenging. I find it difficult to comprehend…I had never done similar subjects…I am planning catch up during the forthcoming break." The participants were able to see that Student C clearly showed planning in his self-management skills. An insight here was that students may need more support to enable them to get to higher levels of self-directed learning, to avert failure and attrition. Dependence can occur if the learner is learning very new topics or subjects. This is what Student C exemplified in this reflective piece.

Student C:

> To talk a bit about what I am enjoying about PBL, I am enjoying researching from libraries and Internet. I also like the idea of working in groups with our supervisor Juan, who sets us up for the projects when we meet every Tuesdays for an hour. After this, it is up to us to give individual tasks to each person. The other thing I am enjoying about PBL is the practical aspect of study, in which I have not really confronted before. On the other hand, I still am facing a few challenges/difficulties with PBL. One of them being time management. The first two problems proved that I did not utilize my time very effectively as I had trouble meeting all the deadlines, such as the very first week when I had problems constructing the robot kit. However, as time went past I had continued to improve this challenge.

The fourth text the participants analysed was Student D's reflective piece. Student D's piece shows a positive attitude towards PBL in general and self-/participant-directed learning. The analysis showed that Student D is deficient in lifelong learning skills, namely information searching and evaluation. He admits, "The main challenge…in PBL is researching." Failure to evaluate information was also indicated in the text "it's also hard to be able to pick out exactly what you want from the information". Thus, while the student appreciates the PBL approach, he certainly needs support to enable him attain the lifelong learning outcome.

Student D:

> I think that PBL is one of the best methods of teaching in the world, since it trains us to solve any real live problems that may occur later in our jobs. Surly, it's the best but I only enjoy it when I finish my assignment. The main challenge that I've faced in PBL is researching. To find the required information to solve PBL problems is quite hard. Sometimes it takes me hours and hours just to find very small details about a problem I also find that learning from researching is hard because if you do find information it's also hard to be able to pick out exactly what you want from the information provided.

By analysing all students' reflective written pieces, problems the students faced have been identified and strategies to address the problems have also been developed. The sum of problems identified through textual analysis and strategies that the participating staff came up with to address students' concerns are listed below:

- To address inadequate skills to manage team work, workshops were arranged for the students.
- It was noted that the generic problem of lack of research skills was diverse. For example, some students lacked information literacy skills and as a result they did not know how to find the right information for the PBL problems. Some of the students were able to find information but did not know how to narrow down the information found. Additional and remedial help from staff and library were arranged to address the problem.
- To address uncertainty about how to prepare the portfolio, the PBL supervisor was advised to explain to the students the learning outcomes of the PBL unit and explain to the students individually, in a team or in a group, how to address the learning outcomes in the portfolio.
- There were general problems with lack of social (leadership) skills. For example, some learners in leadership roles did not know how to deal with team members who did not contribute to the team work. To address this, a workshop was organised and experts from another faculty were invited to give presentations on group dynamics.
- Inadequate self-management skills showed mostly as lack of time management skills. Again, a workshop was organised to address the problem and handouts were given to the students on how to manage their time effectively.
- Some students indicated that there lacked tutorial time for the parallel non PBL subjects. In response more tutorial times were arranged for non PBL subjects such as Programming, Mathematics, Physics, and Circuit Theory in the second half of the semester.

Conclusions

This paper focused on a program conducted between staff from the School of Electrical Engineering and the School of Communication, Culture and Languages to develop further integration of language across the curriculum skills into the engineering curriculum, and to assist the electrical engineering staff in meeting some challenges presented by the introduction of PBL. A series of workshops have been conducted in the initial phase of the project. The purpose of these workshops was to empower the electrical engineering staff with learning theory and metalanguage in language learning and learning strategies so that they will be able to analyse and evaluate the reports and reflective writings of students. After the staff analysed all students' reflective writing pieces, they were able to identify the problems the students encountered and develop strategies to overcome these problems. In accordance with the aims of the LAC project, the workshops have been a success. Electrical engineering staff feel more confident in addressing language across the curriculum problems that students face in the PBL learning environment. In addition there are significant insights that this project has provided; the project has helped to expose introductory problems in the system which otherwise would have remained less apparent.

Acknowledgement

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