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THE ANALYSIS OF A PILOT IMPLEMENTAION OF PROBLEM BASED LEARNING STRATEGY FOR A LOGISTICS UNDERGRADUATE EDUCATION PROGRAMME

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ABSTRACT

Research findings suggest that a supply chain manager's job is complex and multidimensional, requiring both general management and logistics/supply chain specific knowledge, competencies and skills. The challenge for logistics educators is to design and develop curricula, teaching and assessment methodologies that can support wide-ranging and integrative learning objectives, which include team, people, project management and technological skills.

Problem based learning (PBL) draws heavily on andragogical principles, requiring the student to be self directed and responsible for their own learning as they seek to solve a 'real life' problem, within a group. The paper presents the analysis of the teachers experience of designing and implementing the PBL strategy in a third year module of an undergraduate logistics degree programme. The experience of the students is recorded in a post module survey.

Group dynamics and interpersonal challenges were noted by students. Group assessment in particular was highlighted. Group sizes were also explored and large groups were found to be less effective. An important overall finding was the need for greater training for the students in PBL methods.

Key Words:

Logistics and Supply Chain Management skills and competences, Problem Based Learning, Group Work, Assessment

1.0 Introduction

"In today's globalised and highly competitive environment, supply chains are becoming larger and more complex with globally dispersed components. Effective supply chain management in this environment is a challenging task which can be made more difficult when supply chains face unexpected disruptions." [1]

In the context of a rapidly changing, dynamic business environment, this paper sets out to address how learning and teaching methods can be adapted to meet emerging competence and skills requirements of logistics and supply chain management students/ graduates.

Logistics and Supply Chain Management (SCM) continues to grow in importance as companies continue to pursue outsourcing, expand international operations and work in a global economic environment [2]. As products and services are produced and consumed on a global basis, SCM effectively designs and manages product and informational flows to balance supply and demand. For example, Ford Motors, in order to balance its global consumer SC (supply chain), cut USA production targets to match declining sales figures, whilst increasing production in India to meet increases in demand [3]. China, since entering WTO (World Trade Organisation), has experienced rapid, historically unprecedented, large scale of change in its business climate [4]. It is critical that scholars have understand China's emerging role in the global economy when considering the global Supply Chain (SC).

As logistics and SCM continues to develop, so do competence and skill set requirements. Gammelgaard [5] highlights that logisticians should not only be able to *respond* to existing situations, but must be able to *adapt*. These developments have led to an increased need for quality Logistics and Supply Chain graduates and it is essential to examine Logistics and Supply Chain curricula and its pedagogical approaches.

This paper sets out to examine what industry and research understands a quality SCM graduate to be. It examines the literature on assessment methods available, paying particular attention to Problem Based Learning (PBL), and its utility in assisting students to develop some of these quality and knowledge requirements. This research paper concludes with an examination of a group of honours degree supply chain management students and the application of a PBL assignment. It discusses the changes made to the assignment implementation and management as a result of this feedback. At the time of submitting this paper, data collection and analysis is under completion and the results and their analysis will be made in the presentation of the paper in March 2008.

2.0 LITERATURE REVIEW

The logistics discipline has undergone dramatic change since the early 1990s [2, 6], emphasising globalisation and economic integration, the extended enterprise has taken root, and the increasingly important role being played by the management of the entire supply chain [4]. SCs compete must operate co-operatively to satisfy the ever more demanding end consumer needs. This is a complex and challenging task, especially when mass customisation, shortening product life cycles, outsourcing, continuous developments in information and communication technology, globalisation of markets and businesses are considered [6, 7].

The many definitions of logistics and SCM highlight the differences; logistics is the planning and management of product and information flow, while SCM takes and develops this concept to the planning and management of a wider network of the organisations suppliers and customers. For the purpose of this paper the terms will be used interchangeably. This movement from a standalone logistics discipline, to a SCM discipline, has lead to a change in the nature and scope of the logisticians duties, managerial skills and knowledge over the past 15 years [8]. Pyne et al [9] report that managers must be competent in establishing long term relationships, as growing international trade grows more logisticians into building relationships across cultural divides.

2.1 Skills and Competence requirements of SCM graduates

Gammelgaard and Larson [5] classify current educational requirements of logisticians and supply chain (SC) managers using two terms; **skills** which cover general context independent knowledge and **competences** which refer to experience based and context dependent knowledge. It is the skills that are the general tools and rules taught in most logistics classes, which are vital for the practitioner. However, the competent logistician will have acquired context-dependent knowledge through organisational experience. They demonstrate the link between skills and competences – the competent experienced practitioner has the ability to make synchronic, intuitive and holistic decisions based on analysis and the rules.

If the benefits of boundary spanning management are to be achieved, businesses will have to develop the necessary tools and skills set. Supply chain managers will need training in collaborative techniques, relationship and trust building and skills for compromise. Ballou [2] and Van Hoek [10] highlight that much of the current teaching focuses on technical aspects. However the criticality of the human aspects are becoming increasingly apparent, with SC managers becoming aware of need a team orientation, people and technology skills, cross functional skills and a supply chain mindset their own and their subordinate needs and concerns. Bowmans work which states that while certain competences may be unique to given organisations and industries, many of the logistics management skills are transferable across organisations [5]. Margetson [11] highlights the significance of ensuring curricula, learning and assessment methods align with the changing external environment. This is confirmed by Bradley's findings in 1999 that SCM graduates are in demand in the recruitment market. However, 42% of the logistics professionals state that are not adequately prepared [5].

They summarise their literature review, stating that the SC managers needs to be team players, know everyone's business and become an information expert. Their analysis found that the universal logistics management skills include people, analytical, communication and computer skills, (flexibility),

which cannot be considered as mutually exclusive. Following two rounds of a survey and analysis of a number of cases, they developed a ranked list of important skills for SCM. They represent three distinct skill constructs; interpersonal / managerial basic skills, quantitative / technological skills and SCM core skills, (table 1).

<i>Interpersonal /Managerial basic skills;</i>	<i>Quantitative / Technological skills</i>	<i>SCM core skills</i>
Ambition Critical reasoning Decision making Ethical awareness Listening Motivation Organising Presentation skills Prioritising Problem solving Self directed learning Self-discipline Speaking/oral communication Time management Training Writing/written communication	Database ability IT systems development Computer programming Quantitative methods Software knowledge Spreadsheet abilities Statistical analysis	Ability to see the big picture Change management Confidence Conflict management Cross functional awareness Foreign language Knowledge of the industry Leadership Negotiation Organisation/ cultural awareness Project management Selling Teamwork Knowledge of the latest technology Knowledge of the newest techniques

Table 1; Supply Chain Management Skills [5]

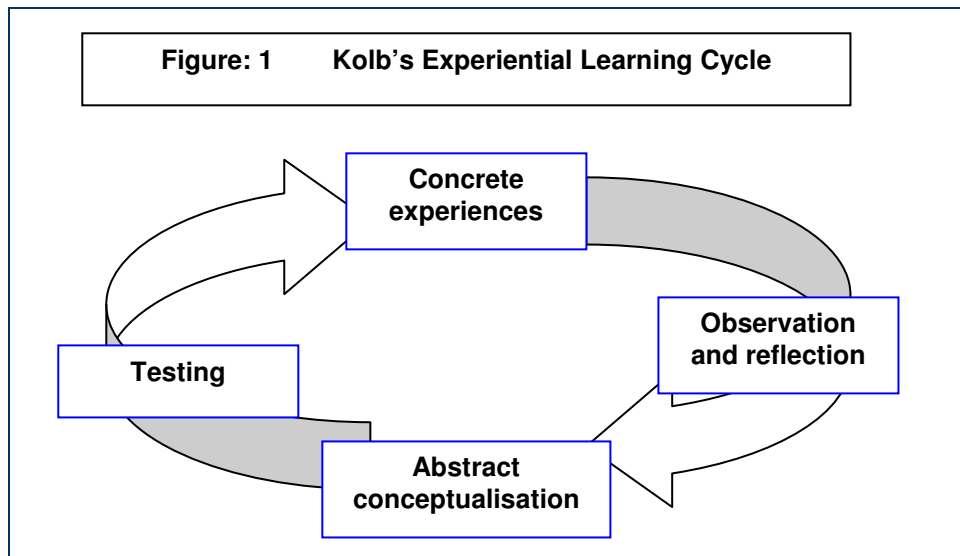
Research by Murphy and Poist [8] recognises that the managerial skills and knowledge of successful logistics and SC professional has changed over the last 15 years. They note that when Dischinger updated their earlier work and despite tremendous macro-environmental changes over 15 years, a logistician must be a manager first and a logistician second.

2.2 Learning, Teaching and Assessing the Supply Chain Management Student

2.2.1 Learning styles

Students differ as to their preferred learning styles and learning centred teaching involves being able to cope with these differences. Kolb [12] believes that most humans learning comes from experience rather than formal education and he promotes Lewin's ideas about the cyclic nature of learning in education and training. Sparkes [13] summarises that some students are 'holists', while others are 'serialists', where the holist learner takes an overview and then begins to fill in the details. The serialist learner on the other hand follows a logical step-by-step progression of the subject. Students can also be categorised as visualisers, verbalisers and doers. The visualiser's learning is helped by the inclusion of diagrams, pictures etc, the verbalisers prefers to listen, read, discuss, argue and write in order to learn and the doer learns best from overt practical activity. There are more classifications which are not discussed here.

It is recognised that for students to develop understand and knowledge, it is important to adopt a 'deep approach' to their learning. Kolb [12] describes effective learning as consisting of four stages in an experiential learning cycle; concrete experience, reflective observation, abstract conceptualisation and active experimentation (fig. 1). In order to learn successfully, people must have opportunities to have an experience, reflect on it, make generalisations about it to place it in a conceptual framework and use this to plan to tackle a new situation [14].



The fact that students are not homogenous, but have different effective learning styles has important implications for course evaluation. There is agreement that time needs to pass before students can access the effectiveness of assignments; 'it only on reflection that you can see the value and worthwhile skill that has been acquired' [13]. Blended Problem Based Learning (PBL) is seen as an effective way to allow students to learn experientially suiting their own learning style. 'Learning takes place through the active behaviour of the student: it is what he does that he learns, not what the teacher does' [14].

2.2.2 Constructive Alignment and Assessment

The position of assessment in higher education is being discussed from a number of differing perspectives; firstly as a reliable measure of competence and improvement through tests, secondly as a means of demonstrating effective curriculum learning and finally consequential validity as the assessment steers learning [15]. Assessments can be formative or summative, however the choice of assessment to be used; exams, cases, essays, reports, reflective journal; should be based on its reliability and validity, in other words is it assessing what they should be assessing [14].

There is a need to constructively align teaching, learning and assessment [14], without ignoring the subject (the curriculum) in which the student is being assessed [15]. Constructivism centres on the belief that realities are understood in the form of multiple constructions that are socially and experimentally based (Biggs 1999, p26). Biggs believed that curriculum design should begin with the question 'what do we want students to be able to do as a result of learning'. Savin-Baden purports that curricula where PBL is central to the learning are in fact largely constructivist in nature because students do, to a large extent, make decisions about what counts as knowledge and knowing [14] [16]. However, learning can be undermined by the assessment processes, especially if they are too authoritarian based.

2.2.3 Problem based learning (PBL)

The use of PBL began with medical students before its application to many other disciplines. It promotes a person centred model that 'proposes an evaluative and reflective approach to improve the learning and teaching experience of both students and staff' [16]. The **aim** of PBL is to develop understanding and comprehension, to teach 'know-how' and to encourage students to seek out best practice and apply it to well known problems, which are nevertheless new to students. It reflects the way people learn in real life [14] [16]. The central proposition of PBL is that content is learned in the context in which it is used; that is, learning is approached holistically rather than within the boundaries of artificial (or skill) based compartments [17]. The PBL approach is a cognitive apprenticeship simultaneously focusing on both the knowledge domain and the problem solving associated with that knowledge domain or profession. PBL is designed to integrate the subject knowledge students required in order to solve a particular problem and therefore study issues at a deep rather than surface level. Table 2 below, gives an overview of some of the PBL methodologies which are suggested.

A rich learning environment is developed if a typical PBL process is followed – (Biggs 2003);	Centre for teaching, learning & Scholarship, Samford University	An adapted PBL methodology, Stonyer, Heather and Marshall, (2002),
The context is pressing	Education on PBL I and the process	Buy-in; introductory session, understand roles and learning in a different way.
Learners become active very quickly. They are assigned to small problem-solving groups and begin interacting with teachers and peers.	Initial analysis of the problem and activation of prior knowledge through small group discussion	Problem definition; what is the problem(s) what are the learning objectives
Learners start from what they already know , and build a knowledge base on that. Knowledge is elaborated and consolidated	Elaboration of prior knowledge and processing of new information	Understanding the problem What do I know already? What is the problem? How can I model the problem? Where can I find out about the problem or the context in which the problem is located? Can I solve it immediately?
The knowledge is functioning; it is applied to the problem in hand	Restructuring of knowledge and	Learning; What is the Supply Chain knowledge and skills that I need relating to the problem?
The problem is reviewed, and learners develop self-management and self-monitoring skills, which they review throughout the programme.	Social knowledge construction	Problem solving; By drawing together workplace knowledge and Supply Chain knowledge, potential solutions can be developed and evaluated.
		Reflection; Is the problem solved? How can I apply this new knowledge? How have I developed/learned?

Table 2 ; PBL methodologies

There are many **challenges** facing lecturers and students as they seek to adopt PBL as a learning and teaching strategy. These are summarised in Table 3 below. However, it is worth highlighting the importance of group work and communication. As PBL requires students to share their learning experiences and to work co-operatively in small groups, communication skills, collaborative skills and reflective / self evaluation skills are needed. Because of the structure of the PBL tutorials, both the group dynamics and the individual group members can impact on how well a group functions.

Savin-Baden believes that assessment is one of the most controversial concerns in PBL. This can be linked to the group work, attendance only at sessions that are being assessed, assessment criteria, fairness and the clarity of marking criteria. Biggs[14] refers to the fact that crucial assessments should be performance based and believes that universally acceptable PBL evaluation criteria are; Dealing with the initial problem or case, Review of independent study, Final problem formulation

The training and competence of the Facilitator is believed to be crucial to the success of PBL [17]. A Facilitator's role includes being a; content and procedural person, facilitator, guide to additional resources, sounding board and a learner as well. They recommend that the guidance should be progressively faded.

<i>The challenges of PBL Clouston and Whitcombe, 2005</i>	<i>Assessment and PBL Savin-Baden, 2004</i>
<i>Environment</i> Norms in an organisation can hinder or promote the development of the cultural change necessitated for non-traditional teaching methods	<i>Unrewarded learning</i> 'with the emphasis on collaborative learning & a focus on process, as well as content, that the assessment used should reflect & reward those values'
<i>Group dynamics</i> The dynamics of the membership are influential on both the learning experience and outcome. The 'validated knowing' function of learning is based on trust, being valued and being listened to within the group.	<i>Disabling assessment mechanisms</i> ' mismatch between the collaborative ethos of PBL and the outcome focussed assessment that rewarded the individual rather than the group'
<i>Communication</i> Clear systems for communication at all levels within the PBL environment & wider organisation is central to effective PBL implementation	<i>The impact of assessment on group work</i> Ensure student attendance and commitment to PBL. Individuals can hide their lack of work and commitment.
<i>Cognitive dissonance and congruence</i> 'discomfort felt at a discrepancy between what you already know or believe and new information or interpretation'. Happens when you need become open to new ideas.	
<i>Readiness and preparedness</i> Little research on students readiness. May depend on learning style, but it is needed. Tutor also needs training in facilitation & constructive feedback.	

Table 3, Challenges Facing PBL

Group work and Peer Assessment

Cheng and Warren [18] see the use of group work in higher education as becoming common place for sound pedagogical reasons. It facilitates learning and team work and many of the reasons associated with PBL adoption. However, it is recognised that there are also problems such as 'free riding', which leads to resentment and a downward spiral in the efforts of the entire group. The division of labour may mean that the learner only becomes involved in a segment of the groups work.. and finally the assessment of group work presents problems. In group work situations, having peers assess one another's contribution is suggested to overcome these problems. They have tried to develop a model which is valid, reliable, practicable, fair and useful to the students. They developed an IWF or individual weighting factor. The final individual student mark = IWF x final group project mark.

Where
$$IWF = \frac{\text{individual effort rating}}{\text{Average effort rating for the group}}$$

Table 4 assessing group members contributions to group work [18].					
0 Did not contribute in this way	1 Poor	2 Below average	3 Average	4 Above average	5 Excellent
Assessment Criteria	Ideas and suggestions for group project	Literature search	Literature analysis	Planning and preparation of oral presentation	Preparation, planning and writing of report
Group Member					

The individual effort rating (IWF) was obtained by summing the marks for each of the assessment criteria awarded to the individual by the rest of the group. The average effort rating is calculated by summing all the marks and dividing by the number of students. The final group project mark is given by the lecture assessing the assignment and awarding an appropriate grade

The vast majority of group project work assessment using some form of peer assessment as a means of differentiating between individual student contributions. In some methods, there is also an element of self assessment included in a similar manner to the peer assessment. An alternative is to categorise contributions as set out below, C1 to C6. [19].

- **C1: Motivation/ responsibility/ Time management;** Attends meetings regularly, and on time, accepts fair share of work and reliably completes by the required time
- **C2: Adaptability;** Wide range of skills, readily accepts changed approach or constructive criticism
- **C3: Creativity/ Originality;** Problem solver, originates new ideas, initiates team decisions
- **C4: Communication Skills;** Proficient at diagramming/ documentation / presentation slides, effective in discussions, good listener, able presenter
- **C5: General Team Skill;** Positive attitude, encourager, supporter of team decisions, desire for consensus
- **C6: Technical Skills;** Provide technical solutions to problems, ability to create designs on own initiative

3.0 THE STUDY

The research reported in this paper emerged from a realisation, articulated by job placement employers that Supply Chain and Logistics need to demonstrate more managerial and softer skills. This paper examines the feedback from one group of students (honours degree Logistics and Supply Chain Management students in their penultimate year), who completed a procurement management module where PBL was used to assess 50% of their learning outcomes. The learning was made up of the integration of face to face teaching and PBL assessment. The intranet facilities allowed for presentation of notes, links to sites and readings and continuous communication with the students. Whilst there is some criticism of PBL as a teaching and learning strategy, the students responded well, in general, to the introduction of modules which are guided by the principles of PBL. Following five content based semesters, the students spend their 6th semester in paid industrial placement, where they are expected to put their earlier learning into practice. The subjects in the final two semesters, in year 4, set out to further develop the more strategic and cross functional learning and competences in the business, logistics and management skills.

3.1 Research Methodology

The action research methodology adopted was qualitative in nature. Action research is a group process by which change and understanding can be pursued at the one time. It is usually described as cyclic, with action and critical reflection taking place in turn. The reflection is used to review the previous action and plan the next one, thus allowing understanding to be shared and change to be pursued with commitment, [20]. This action research paper presents the results of a critical analysis of the 2006-'07 reflective journals. The changes made to the assignment brief, implementation and management as a result of this feedback are also presented. The 2007-'08 results and their analysis will not be available until the presentation of the paper in March 2008, as they are only being submitted now. It is the *critical systematic reflection* which enables the action research methodology to achieve its research outcomes. The research design of this study has been already been refined as a result of critical reflection by the facilitator and the students. It considered students learning and PBL, the PBL process, management skills and group assessment. Generally the design gets better and fits the situation better as you proceed [20].

3.1.1 The Process;

At the beginning of their fifth semester, the procurement management students were randomly assigned to four groups, of 9 members each. The first lecture introduced the students to their new module, procurement management. PBL was introduced in week two, in a two hour session. This involved explaining and giving them handouts on the PBL ideals, its process, the role of facilitator,

reflective learning and journal and group work. Connemara Foods, the 'real life' problem and its learning outcomes was also given. One introductory session is not enough, as the students had difficulty absorbing the new information. Improvements were made this year, with further changes planned for 2008-'09. The students were given time at each of traditional teaching classes to ask questions. An additional 2 hours was scheduled weekly for the semester to allow for further tutorials. In addition, the students could contact me on-line or call into my office. This is definitely a more time consuming and involved teaching and learning method. Students had access to a wide range of resources; DITs web based e-learning system, which held word and power point procurement management notes, links to relevant web sites and also provided on-line access to the library and all its resources.

Marks for the PBL assessment are divided; 80% written report, satisfaction of the learning outcomes, 5% presentation and Q&A and 15% for the individuals reflective journal. There is a level of trust involved in writing the reflective journals, which has been gained through regular lecturing interaction. They mark they gain for the journal is based on their ability to critically reflect.

4.0 FINDINGS AND ANALYSIS, 2006-'07 REFLECTIVE JOURNALS

The findings presented here are the result of a critical analysis of 32 reflective journals, a response rate of 91%. A content analysis was conducted to identify common themes and categories. This was done initially for each group and then across all groups. Seven consistent themes were identified, with much of the comment reflecting the literature.

1. Role of Facilitator

Forty percent of the student identified the lecturer's new role of facilitator difficult to adjust to. Literature highlights the need for the trained facilitator to stand back and fulfil a new role; Guiding the students in their iterative learning process to solve the problem. At times this involved answering questions with questions. This can be hard initially, despite training, for a lecturer come facilitator.

2. Facilities

Three of the groups said that they liked to work in the meeting rooms in the library. This allowed them to have round table meeting and access to much of the necessary knowledge information.

3. Group work and Assessment

All students complained about the group work and the assessment's marking scheme. As stated in the literature, this is one of the most controversial aspect of PBL learning. Some students did not like the fact that they were carrying the 'free riders' and felt very de-motivated. Others felt that they were being pushed too hard to work at a deeper level than they would do if they were not in a group. Attendance at tutorials was compulsory and there was negative marking for poor attendance, however this did not extend to their own meetings. Literature identified group dynamics as influential on the learning experience, motivation and the outcome. One group experienced a total break down for a short period. However, all recognised the problem and learned from the experience. As all journals mentioned group work and assessment, this became a focus area for the 2007-'08 PBL process, with a number of changes being implemented. Table 4 above was adapted and implemented.

4. Group Work - organisation and management of the meetings

The group size of nine was considered too big by 75% of the students, literature suggests an ideal of 4 -7 and reduced for 2007-'08 groups. When forming the groups, account is taken of the student population diversity; each group has a mix of Irish national, mature, Erasmus and Chinese students, and students who enter in third year from other courses.

An issue raised in all journals, was their lack of organisational, co-ordination and management skills, which ties with the literature on graduates and their lack of soft skills. All groups went through a process of formalising the meetings, letting this fall by the wayside and then realising the need to have formal structures, note taking, chairman, action items in order to be able to effectively manage and solve their PBL problems whilst achieving their learning outcomes.

Another common thread was the iterative nature of a PBL assignment. Each group split the project up into sub-groups, then assigned work to individuals (because of poor attendance and lack of action by some sub-groups), before bringing it back to the sub-groups. The final step happened because

they realised that they needed to manage the meetings and sub-groups in order to ensure that there was coherence through their company, their chosen problems and the learning outcomes.

5. Communication, motivation and leadership

The students identified many of the softer management skills identified in the literature, which demonstrates the effectiveness of critically reflection. Through the PBL process many of the students came to realise the importance of listening as well as talking. The need to have written and oral skills.

Motivated students realised that some students need more 'external' motivation than they do and considered ways in which they could help these students. Time and deadlines were considered great motivators by some. This has led to the setting of interim deadlines for the 2007-'08 groups, whereby the students get results and critical feedback on their progress to date.

Leadership was an issue, with some mentioning their regret that did not come forward in their group to manage meetings, ensure all were heard and delegate tasks. By the end of the process most students had become more comfortable with communicating the good and the bad news; 'you are affecting my progress by not working, please do your work'. However, 9% of the students gave the impression that they wanted the leader' to replace the lecturer and tell them what to do.

6. The Task and Timescale

When the students are initially given the brief and the learning outcomes, there are mixed feelings; great this is different and will allow us to be creative, lets get going, to, this is so big and so new, how do we tackle it. 'Where will we start'. 'It is a daunting task'.

Approximately 15% of the students found the iterative nature of PB Learning difficult. They did not understand that it was part of the learning process to go down blind alleys, discard information and restart. This is how it happens in real life. Some found it hard to identify what the problems were, for others the problem was linking the learning outcomes, company's problems, knowledge available on-line and the lectures. Time and scale are also an issue, feeling they had forever to complete it. This was changed for the 2007-'08 students

7. PBL reflection

There was 4 student who did not like group work and who hated the PBL process, even following critical reflection. Whilst the remainder, even though some were disappointed with their marks, had positive comments on PBL. 'it was a great experience'. 'a good assignment, as near to real life as possible', 'feel would be able to tackle any assignment in the real world'. They stated that by improving analytical, communication and teamwork skills they learnt how to put different pieces of work together. They learned to work constructively in a group and understand others point of view, as well as learning to listen and talk constructively. That is important not to sit and gripe but to be proactive.

5.0 CONCLUSION

As in any action research project, more knowledge has been gained and lessons have been learnt which will lead to further changes and developments in the application and management of the PBL process for this group of Logistics and Supply Chain Management Students. This action research has highlighted the need to align the curriculum, assessment and students learning with the changing industry requirements for Supply Chain Management graduates.

In practice, DIT maintains industry, curricula and assessment alignment for its SCM degree programme through feedback with an industry questionnaire. PBL is proving to be a suitable learning and assessment method, as it helps the students to address their management skills and develop SC knowledge. As a result of a pilot study of PBL assignment in 2006-'07, changes were made to for the 2007-'08 students; These include; begin the PBL process in week one with a training session in week one and another in week 3; split the learning outcomes into manageable submission sections, with individual dates, reduce the size of the groups, introduced a PBL meetings/ diary template, introduced peer assessment, better tied the lecturing coverage, to the assignment progress, feedback sheets and marks during the term and finally, a final report which allows them to pull the whole project together. The results of the 2007-'08 reflective journal analysis will be available at the conference in March 2008 or can be provided by writing to the e-mail address above.

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