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Introducing Problem Based Learning in Higher Education

Thomas Ryberg, Bente Nørgaard *

INTRODUCTION

On behalf of the editorial team and the editorial board we are happy to introduce the very first issue of *Journal of Problem Based Learning in Higher Education*. Establishing a new interdisciplinary and international journal is an exciting experience that requires many people's cooperation and work. We are therefore grateful to the editorial board for their work on shaping the scope and aims of the journal, disseminating the call, contribute with papers and suggesting reviewers. To the reviewers who have taken time to read, scrutinize and provide critical commentary for the papers. And of course to the authors who have contributed with a wealth of interesting papers on Problem Based Learning in Higher Education. We are very happy with the breadth and depth of the papers, and we are truly amazed with the international spread of the authors with contributors from Australia, Asia, North America and Europe.

The Journal of Problem Based Learning in Higher Education is an Open Access journal meaning that all papers published are freely available to researchers and the general public. There is no subscription fee, no publication fee and no pay-wall. We believe this is particularly important because Problem Based Learning as a pedagogical philosophy and educational method is attracting attention in parts of the world where economic difficulties can hinder access to recent research. Although peer-reviewing, authoring and editorial work is considered part of academic practice running a journal is not free of costs. We would therefore also like to thank the Aalborg University board of Executive Directors for providing some basic funding for running the journal; Aalborg University Library for hosting and supporting the JPBLHE website and submission system (which is built on the open source system Open Journal Systems (http://pkp.sfu.ca/?q=ojs)) and Aalborg University press for being the official publisher of the journal.

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BACKGROUND OF THE JOURNAL

The idea and foundation for creating JPBLHE emerged as an outcome of the establishment of the PBL academy at Aalborg University (www.pbl.aau.dk). The PBL Academy at Aalborg University (AAU) is a-cross faculty initiative to ensure the continuous development of the Aalborg University Model of Problem Based Learning (PBL). However, to ensure a vibrant development of PBL it is of the utmost importance to keep up with international research, and to contribute to ongoing development of PBL as an area of research. Therefore, one of the goals of the academy was to initiate an international, interdisciplinary open access journal with a specific focus on PBL in Higher Education. The journal has thus emerged as a collaboration between a number of research environments in Aalborg University e.g. "The UNESCO chair in Problem Based Learning", "e-Learning Lab – center for user driven innovation, learning and design", and "the Department of Learning and Philosophy" to name a few. Although the journal has grounding in these environments the ambition is to create and sustain a truly international and interdisciplinary journal. In relation to this, it is also important to emphasise that the journal does not foreground or favour particular approaches or PBL models. Rather, the aim is to explore, discuss and render visible the many different ways in which PBL is practiced within Higher Education. Therefore, we have aimed to establish a broad, internationally oriented Editorial Board composed of prominent and esteemed researchers within PBL; and we hope to be able to continuously expand the Editorial Board, the Editorial team, and the number of reviewers and authors. With this first issue, we feel that we have managed to attract both an international and interdisciplinary set of papers and authors, and we hope the readers will find the discussions and findings as interesting as we do.

INTRODUCTION TO THE FIRST ISSUE

The issue is composed of fifteen research papers that, from our reading, fall within four thematic areas:

- Theories, principles and philosophy of PBL in Higher Education
- Case studies of PBL and reflections on PBL in practice
- Implementing PBL or principles of PBL
- PBL and networked learning

Although we have not made explicit special sections for different themes, the sequence of the papers in this issue reflect these thematic areas.

Within the first thematic set of papers various theoretical constructs are explored, and the authors query into the theoretical and philosophical underpinnings of various implementations of PBL. *Andrew Armitage* discusses Paulo Freire's concept of *"Conscientization"* as central

to a problem-posing pedagogy, and illustrates with tales from the field, how dialogue groups can be used to explore a problem and understanding its constraints, options and multi-voiced nature. *Thomas Szulevicz & Mogens Jensen* discuss whether PBL is prone to a content-form dualism leading to a focus on form (the problem) over the content of learning. Also, they ask whether PBL might potentially lead to an individualisation of the learning process, as they argue much PBL-literature tends to understand learning as acquisition of knowledge, thus ignoring identity-related processes in learning. *William Vickery* introduces the concept of "scrounging", which is adopted from studies of animal behaviour. Scroungers are animals that exploit resources found by other group members, rather than finding resources themselves. While scrounging can be a necessary and productive part of social learning, there is a danger if some are mainly "free-riding". The author explores how to encourage scrounging as a cooperative tactic, while minimising its negative impacts on group performance (free-riding). Finally, *Verner Larsen* explores the notion of "transversality" or "transversal knowledge formations" as an alternative to inter-, cross-, or trans-disciplinarity. He does so through studying, comparing and contrasting two institutional arrangements in order to demonstrate how their practices reflect different understandings of "transversal knowledge".

Within the second thematic set of papers the authors explore a number of cases and literature on PBL to study the limitations, potentials and aspects of different PBL practices. *XiangYun Du, Jeppe Emmersen, Egon Toft, and Baozhi Sun* explore the relationship of problem-based learning and the development of critical thinking disposition and academic achievement in Chinese medical students by using a cross-sectional randomized design comparing PBL students with non-PBL students. The authors conclude that the PBL teaching was related to a higher disposition of critical thinking, but did not lead to improved academic skills compared to the non-PBL students. *Forough L. Nowrouzian and Anne Farewell* conduct a survey of the current literature to explore the development of team-work skills in Biomedical Science students when using PBL. They argue that in research practice team-work in laboratory is becoming the dominant form of practice and that this development requires students gain experience of team-work before they start their professional career. *Noreen O'Shea, Caroline Verzat, Benoit Raucent, Delphine Ducarme, Thérèse Bouvy, and Benoit Herman* investigate how PBL student teams develop specific leadership configurations when implementing interdisciplinary projects, and whether or not tutors help dealing with the group interactions that are subsequently generated. While the authors found that tutors positively perceive their role in facilitating production outcomes they are more uncomfortable when it comes to regulating the interpersonal problems that arise in self-managed teams of students. *Rosalind Murray-Harvey, Tahereh Pourshafie, and Wilma Santos Reyes* report experiences from a study of 122 Australian teacher education students working collaboratively in a PBL setting. The students provided written reflections on PBL that enabled representations of their group work experiences to be mapped using an Attitude, Skills, and Knowledge (ASK) framework to understand what they valued about the collaborative learning process (both as students and as future teachers). For example, the attitudes identified as necessary for collaborative

learning were valuing others' perspectives, interdependence, and learning about self. *Manuel Cabral Reis, Emanuel Peres, Raul Morais, and Joaquim Escola* present and discuss a set of pilot courses (non-mandatory) proposed to the students at the Engineering Department of the University of Trás-os-Montes e Alto Douro (Portugal). The authors discuss design and implementation issues, and how problem-based learning and experimental lab learning classes were supported. Further, they analyse the final assessment results, as well as the opinions of the students.

In the third thematic set of papers the authors explore, analyse and discuss various implementations of PBL or PBL principles. *Nikolaj Stegeager, Anja Overgaard Thomassen, and Erik Laursen* present the PBL model applied at Aalborg University to discuss the educational effectiveness of this model in securing an efficient transfer of learning from university driven continuing education to the context of the workplace. Drawing on research from two qualitative studies they discuss why the Aalborg PBL model, in spite of intentions of closing the gap between education and working life, seems to have some important challenges. They conclude by suggesting some pedagogical guidelines for the design of future PBL-organised academic activities within continuing education. *Huichun Li* argues that a large numbers of higher education institutions are currently transforming their traditional educational approaches to PBL. The author studies a particular university in the process of transforming its traditional educational paradigm to PBL. He shows how there is a lack of unified understanding of what PBL is within the university, how several different PBL interpretations emerge, and how some of them are quite inconsistent with, or even contradictory to each other. This, the author argues, poses significant challenges to a university when implementing PBL. *Prarthana Coffin* argues that staff development is a crucial element for educational intervention when transitioning from a traditional teaching paradigm towards PBL. Her study aims to pin-point suitable methodologies in developing a Problem-Based Learning (PBL) academic staff development program for a higher education institute. She asks how academic staff can be assisted in acquiring pedagogical competences for an implementation of a PBL curriculum, and what kinds of support academic staff need in order to maintain a PBL implementation. Based in literature, interviews with PBL experts, and document analysis of reflection notes from 18 trainees from a PBL workshop she suggests some guidelines for developing an academic staff development program for an institution working to implement and retain PBL as an educational strategy.

In the final thematic set of papers the authors discuss the role of ICT, online collaboration and networked learning in relation to PBL. *Lars Birch Andreasen and Jørgen Lerche Nielsen* discuss PBL and project work based on and reflecting the experiences of the authors. A specific focus is how the problem- and project-based learning approach has developed in Denmark historically and theoretically, and how it unfolds today. They discuss this based in the Danish Master programme in ICT and Learning (MIL), and focusing on changes in the roles of teachers as supervisors, and the involvement of students in course and project

activities. They emphasise four aspects as central to a contemporary approach to problem- and project-based learning: the exploration of problems, projects as a method, online collaboration, and the dialogic aspect of students' project work. *Catherine Hack* argues that web 2.0 technologies, such as social networks, wikis, blogs, and virtual worlds provide a platform for collaborative working, sharing of resources and joint document production, and can act as a stimulus to promote active learning and an engaging, interactive environment for students. As such they align well with the philosophy of Problem-based Learning. Despite the recognition that technology has an important role in enhancing PBL, the author argues that academic staff can be reluctant to use it. Her paper therefore provides some illustrative examples of how technologies have been used to enhance, scaffold and assess PBL, and she discusses the benefits and limitations of using technology for both staff and students. In the final paper *Joseph Williams, Rich Rice, Ben Lauren, Steve Morrison, Kevin Van Winkle, and Tim Elliott* discuss theories of PBL and Universal Design for Learning (UDL) within the context of an online doctoral program with two weeks mandatory residency. They explore how New Media and Rhetoric students learned how to learn from each other, to develop key skills, and to negotiate the production of deliverables via a radically restructured PBL course in a media lab. They argue that without a distinct and specific audience, course content often remains theoretical and abstract, and students struggle to generate meaningful and effective communication. In the paper the authors show how technology rich learning settings, UDL, and PBL can be used to meaningfully strengthen students' opportunities for learning through scaffolded instruction and a flexible, hybrid course design.

From reading the papers comprising this first issue it is difficult to draw out one or two key points that would guide us in our common future research. As noted by Barrows (1986) and Kolmos & de Graaff (2003) the label 'PBL' covers an amazing diversity of educational practices:

"The term problem-based learning must be considered a genus for which there are many species and subspecies. Each addresses different objectives to varying degrees. All description and evaluation of any PBL method must be analysed in terms of the type of problem used, the teaching learning sequences, the responsibility given to students for learning and the student assessment method used." (Barrows, 1986, p. 485)

"As even superficial inspection of a few of the available sources can reveal, the label 'PBL' is used to cover an amazing diversity of educational practices, ranging from problem-oriented lectures to completely open experiential learning environments aimed at improving interpersonal relations." (Kolmos & Graaff, 2003, p. 657)

From an editors' perspective we have therefore sought to make the authors' explicate their theoretical understanding of PBL, as well as their actual course designs or methods. As clear from the citations PBL covers a diversity of practices and span from being applied in

individual courses to being the foundational pedagogy in entire institutions. We feel that this issue of JPBLHE reflects this diversity, and is also a means for the research community to start exploring these multiple practices and learn from each other.

Therefore, we hope you as reader will enjoy, disseminate, criticize and discuss this issue of JPBLHE; and we hope you will feel welcome and inclined to publish your research in one of the hopefully many future issues.

Thomas Ryberg and Bente Nørgaard

On behalf of the Editorial team and the Editorial board:

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Conscientization, Dialogue and Collaborative Problem Based Learning

Andrew Armitage *

ABSTRACT

It has been argued that Paulo Freire's concept of conscientization, where critical awareness and engagement are central to a problem-posing pedagogy, provides the philosophical principles to underpin Problem Based Learning (PBL). By using dialogue groups and a combination of learning strategies to discover the nature of a problem, understand its constraints, options, and multi-voiced perspectives, students can negotiate the sociological nature of its resolution and how competing perspectives may inform decision-making. This paper will first present the background of PBL, before it introduces and argues for reflective and reflexive learning environments founded within dialogical practices. It then provides tales from the field that illustrate how conscientization is enacted in the classroom, before considering implications and the Ten Principles of Critical Learning' for reflective and reflexive practice. It concludes by arguing that conscientization and the dialogical process are central to PBL in order to engage the individual voice, foster democratic practices, and for the creation of shared meanings and understandings.

Key words: *Conscientization*, Dialogue, Problematization, Reflexivity, Constructivism

INTRODUCTION

Problem Based Learning (PBL) unlike traditional learning actively engages the student in the construction of knowledge (see, for example, Wingspread, 1994; Boyer, 1998) where the role of the tutor is to guide and challenge students rather than to transmit knowledge (Dolmans *et al.*, 2005; Hmelo and Barrows, 2006). An essential aspect of PBL is feedback and reflection on the learning process where group dynamics are central components to the creation of knowledge. Learning is therefore a self-regulatory process of dealing with the conflict

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between existing personal models of the world and new insights an individual encounters, being the reconstruction of new representations of reality, meaning-making and its negotiation through cooperative social activity, discourse, and debate (Fostnot, 1996). It has also been argued, that PBL is not a particular way or method of learning but rather one that takes on a variety of forms (Boud, 1985; Barrows, 1986).

Boud (1985) has suggested that PBL differs according to the context and disciplines it is practiced within, where students bring their personal experiences to, and take responsibility for their learning journey, and is a learning space where the integration of theory and practice takes place and the tutor becomes less directive and more facilitative. Practice Based Learning also focuses on the learning process rather than product of knowledge acquisition, and an emphasis upon communication and interpersonal skills. Savery and Duffy (1995) define the learning goals of PBL that go beyond those of self-directed learning, content knowledge and problem solving to include competence in the essential skills of literacy and numeracy, information finding and retrieval, goal setting, time management, question-asking behaviour, critical thinking and comprehensive self-monitoring and evaluation. This implies that self-directed leaning assists students to become sensitive to their learning needs and abilities in locating and using appropriate information resources (Candy, 1991). This has been argued as being central to the process of PBL for clarifying and agreeing on terms and concepts that are unclear, defining the problem and reviewing terms which are in need of more explanation, brainstorming to create and evaluate potential hypothesis, generating and prioritizing learning objectives, the division of workload, private study time to research objectives, reporting information, and creating an explanation and synthesis of new information in relation to the problem (Schmidt, 1983). According to Barrows and Tamblyn (1980) PBL requires individuals to understand the concepts, rules and principles of problem solving, and the hypthetico-deductive inference skills to generate hypotheses and formulate solutions (Gagné, 1985) enabling students, working in groups to identify and develop viable learning solutions through self-directed learning in order to address complex, real world situations, which have no "right" answer, and where the tutor acts in a facilitative capacity. This according to bell hooks (2010, p.43) is central to an engaged pedagogy that:

> 'produces self-directed learning, teachers and learners who are able to participate fully in the production of ideas….Learning and talking together, we break with the notion that our experience of gaining knowledge is private, individualistic and competitive. By choosing and fostering dialogue, we engage mutually in a learning partnership'

Dialogue is central to Paulo Freire's concept of *conscientization* (Freire, 1972), which Barrett (2001) has argued provides the philosophical principles to underpin PBL, this being a problem-posing pedagogy where education is the practice of freedom and where critical awareness and engagement of the learning process are actualised through problematization and dialogue (bell hooks, 2010). Problematization is a process of defamiliarization of

common sense (myth), where an individual considers their situated reality and invites other people to transform their situation. For Freire, problematization is the first step of critical pedagogy using dialogue to demystify a problem in order to challenge taken for granted knowledge, allowing new viewpoints, consciousness, reflection, hope, and action to emerge (Crotty, 1998). As Montero (2009:79) notes 'As a critical process, problematization generates disagreement, doubts, and discussion, as simultaneously, it starts a process of consciousness mobilization leading to *conscientization*, inducing transformations in the modes of understanding certain phenomena'. Furthermore, value of *conscientization* is not only about acquiring skills, becoming a self-regulated learner, and the acquisition either practical skills and competences, but rather its concerns are focused upon individuals becoming critical, enlightened citizens capable of critically engaging with, and transforming the world. It is a critical enterprise that aims to destabilise and question deep rooted disciplinary knowledge, assumptions, and ideas. In essence, *conscientization* challenges the fundamental principles upon which paradigmatic knowledge, its values, and rhetorical stance is founded upon. It can therefore be argued that PBL takes a social constructivist approach to learning where learner's and tutors co-create knowledge together in participative and collaborative learning environments. Furthermore, through social negotiation with group members, students have opportunities to compare and evaluate their understanding of subject matter with each other through what Barrett and Moore (2011) describe as dialogical knowing, this they claim being central to collaborative PBL practices. It will therefore be argued that reflective and reflexive learning environments founded within dialogical practices are central to the process of *conscientization,* before providing tales from the field that illustrate how it is enacted in the classroom. The implications of PBL and the *Ten Principles of Critical Learning'* for reflective and reflexive practice will follow, before concluding that *conscientization* and the dialogical process are central to PBL in order to engage the individual voice, create democratic practices, and for the creation of shared meanings and understandings for those who take part in the PBL process.

CONSCIENTIZATION, DIALOGUE AND PROBLEM BASED LEARNING

> 'it is only by means of an education that does not separate action from reflection, theory from practice, consciousness from the world, that it is possible to instil a dialectic form of thinking that will contribute to man's integration as a subject into historical reality'
>
> *Paulo Freire, Quelques idées insolites sur l'éducation*

Conscientization is the process whereby an individual becomes engaged with transformative, democratic, and humanistic pedagogical practices, and are not mere receptacles of reality but who as 'knowing subjects achieve a deepening awareness both of the socio-cultural reality which shapes their lives and of their capacity to transform that reality' (Freire, 1972:51). As

Freire notes *consceintization* is where individuals gain the capacity to transform their lives as they become aware of their ability to challenge taken for granted practices, and is a process that enables them to liberate and take control of their own destinies. Freire contends that people must first critically recognize how their reality comes into being so that their 'transforming action can create new realities, which makes possible a fuller humanity' (Freire, 1972, p.29) and where an individual 'exits *in* and with *the* world', this being essential to transformative, democratic, and humanistic pedagogical practices (Freire, 1972, p.51). Freire (1972) describes the process of *conscientization* as having three stages. The first is magical awareness where individuals explain the events that shape their lives in terms of forces and powers beyond their control, and understanding. The second stage is naïve awareness where individuals, although not passively accepting their situation, nevertheless still accept the values, rules, and social order they find themselves in, but still have an incomplete understanding of their lived situation. The third stage is critical awareness or consciousness whereby individuals look more critically at their lived reality, and start to question the values, rules and expectations of passed down by those who oppress, have power and control over them. As such, *conscientization* is not purely a process of individual development; it is also located within the context of the collective, in mutually supportive horizontal relationships.

Gajardo (1991, p.40) notes that *conscientization* introduces notions of reflexivity into the learning process, and that a c*onscientizied* person is the 'subject of the processes of change, actor in the management and development of the educational process, critical and reflexive, and capable of understanding his or her reality in order to transform it'. Furthermore, Freire's conception of *conscientization* is not just verbal interaction, as traditional education is, this being regarded as ineffective and the mono-directional transmission of knowledge from teacher to student via the so-called "banking" method, but rather it can only be achieved through a dialogical encounter, where the student is fully involved in the educational process (McCowon, 2006). For Freire (1972, p.57) the "banking" method of education emphasises permanence and becomes reactionary, whereas problem posing education does not accept neither a 'well behaved present nor a pre-determined future....it roots itself in the dynamic present and becomes revolutionary'. Freire (1970 and 1972) argues that *conscientization* is attained through the dialogical process and critical reflection, which facilitates a critical pedagogy, which is a problem posing education that focuses upon the concerns of the student-teacher relationship, the learning context and the process of learning. Freire is emphatic that learning is founded upon *praxis*, this being a dialectic process of reflection and action, stating that 'discovery cannot be purely intellectual but must involve action; nor can it be limited to mere activism, but involve serious reflection' (Freire, 1972, p.47). As Bolton (2001) notes reflective practice is a dynamic and challenging process requiring those who partake in its process to question through dialogue, their personal and professional practices, and the impact these will have on wider society and individuals they interact with (see also, Lehman, 1988; Power, 1991). Barrett and Moore (2011, p.115) have introduced within the context of PBL, the concept of dialogic knowing, which is 'a concept that is at the heart of problem-based learning and a key idea underpinning all good learning'. They go on to note that dialogic

knowing is where people create and re-create knowledge together, and argue that students and tutors can maximize their potential for the emergence of dialogic knowledge in the context of PBL tutorial settings by talking and listening to each other, by sharing ideas, by confronting divergent views, and by approaching problems in interactive, collaborative, communicative ways. Furthermore, dialogic knowing is the construction and the creation of democratic social relations by co-constructing knowledge through collaboration, whereby individuals embrace shared meanings in the PBL learning process (Barrett and Moore, 2011). Savin-Baden and Major (2004, p.74) have also noted that dialogic knowing is essential to the reflexive team, this being an:

> '….organizing principle, and thus it involves explicit shared reflection about the team process and findings of the learning needs of the team…. Students in such teams are expected to feel able to point to unease connected to both with their role within the team, the relationship between their individual concerns….and the nature of support in the team'

Calas and Smircich (1992:240) have also advanced the idea of reflexivity that 'constantly assesses the relationship between "knowledge" and the ways of "doing knowledge"' and where 'we contextually recognise the various mutual relationships in which our knowing activities are embedded' (Steier, 1995, p.163). This approach to learning involves explicit shared reflection about the team process and findings of the learning needs of the team, rather than masking the paradoxes and conflicts that emerges at almost every stage in most learning teams. As such, individual students by making themselves and their learning the focus of analysis are able to value alternative perspectives of the world, and dialogue is regarded as being central to the process of deconstruction and reconstruction of theirs and others' lives in order to make sense of roles and relationships (Savin-Baden and Major, 2004). According Roebuck (2007) reflexive practice together with reflective practice can be described as a process of inquiry which facilities appreciation and understanding of contextualised views (outside the learners own experience), a deeper learning experience, the development of ideas, and conditions for actual change.

Cunliffe (2004) has noted that reflexivity is where students and the teacher are engaged in a process where their roles are more equal and where 'Critically reflexive practice embraces subjective understandings of reality as a basis for thinking more critically about the assumptions, values, and actions on others'. Cunliffe (2004, p.407) claims that reflexive practice is important to management education, because 'it helps us understand how we constitute our realities and identifies in relational ways, and where we can develop more collaborative and responsive ways of managing organizations'. Cunliffe (1999, p.8) suggests individuals construct social realities, and that they we need to recognise critical management suppositions and reframe them in the 'context of everyday lived experiences and our ideas of learning' and that 'organisational realities and identities are interwoven in a continuous

process of mutual construction; we co-construct our realities in our conversations (Prasad and Caproni, 1997). Prpic (2005) claims that reflexive practice is a three stage process whereby individuals examine, refine, attain knowledge, self-awareness, and how they operate in their professional work settings. The first stage is the intra-view stage where an initial reflection process takes place and the participant (student) attempts to find a deeper understanding of a new concept, an experience or of self. Understanding and meaning are acquired through active and deliberate individual reflection facilitated through contemplative thinking, and the individual comes to see themselves differently in the world, and that the views of the collective. The second stage is the inter-view stage where active discussion takes place, Here, the student may find new assumptions about knowledge, and where the self and the world are challenged. This requires a commitment to understanding other views, whereby dialogue is central to this process. Third stage is where the views of the individual or collective are considered (students and teachers together), and requires individuals to actively reflect on their initial thought in light if the discussions that have taken place in the inter-view stage. Barrett (2005, pp.21-22) argues that reflexivity and dialogic knowing is 'where teachers and students co-construct knowledge and shared understandings', and have implications for PBL practices 'where students are considered to be active agents who engage in social knowledge construction'. Problem Based Learning situates students in simulated and working professional contexts that address policy, process, and ethical problems, and it has been argued that purposefully designed and successful small group learning facilitates the development of a learning environment that supports and promotes both cognitive and meta-cognitive development and small group work is an integral part of the PBL approach to achieve learning outcomes (Newman, 2004; Benson *et al*, 2001). Implicit in the design of PBL is small group work where co-operation between individuals together with the tutorial process, and the use of scenarios, help students to learn how to learn in groups and learn how to anticipate, prevent, cope and deal with the difficulties that they will experience working in this way (Newman, 2004).

According to Newman (2004) small group work enables students to take on a variety of roles, for example, to facilitate or chair discussions and debates, research materials, or be responsible for the collation of ideas and solutions that are to be presented to peers in plenary sessions. This emphasises the need that students are required to take responsibility for their learning process in a group situation, the development of facilitation skills, this being an important part of their roles in a supportive environment (Benson *et al,* 2001). Whilst there are differing opinions as to the size of PBL group work, it has been argued that communication skills, the development of knowledge and collaboration are best achieved with five and ten group members (Myers, *et al*, 2000; Benson *et al*, 2001). This suggests that PBL assists in the process of creating meaning and building personal interpretations of the world based on experiences and interactions with others, and guides the student to bring theory and practice together during their learning journey (Edens, 2000). Therefore the beginnings of a critical and reflexive pedagogy commences in praxis where students become

conscientized, and acquire the skills of the "collective dance" to enable problem based learning to take place. As Lähteenmäki and Uhlin (2011, p.145) note 'It is important to remember that learning always happens in social, cultural, and political contexts' and Savin-Baden and Major (2004) have also shown how group members have to take into account the holistic situational context of their relationship to other people and place. It can therefore be argued that self-emancipatory and self-empowering practices are essential characteristics of students being able to take control of their own situated reality (Bolton, 2001), and as Montero (2009:77) notes:

> 'If participation is the cornerstone for methods development in community-orientated work with a liberating aim, dialog is its complementing aspect. It introduces polyphony as the multiple voices of the participants are heard and responded to'.

As such, dialogue brings together the teacher and the student in the joint act of knowing and re-knowing the object of study, where instead of transferring knowledge statically, as a fixed possession of the teacher, it demands a dynamic proximation towards the object, and is a learning space where people create and recreate acts of knowledge through the process of *conscientization* (Freire, 1972). Furthermore Shor (Shor and Freire, 1987, p.49) has argued that dialogical learning leads to illumination because:

> 'Traditional methods, the transfer-of-knowledge approaches are burdensome precisely because they can't work! [and] The dialogical method is work also, but it holds out a potential of creativity and breakthrough which gives it unusual rewards, mutual illumination'

Mutual illumination has resonance with Barrows (1996), who within a framework of instructional pedagogical methods, has characterised PBL as student-centred learning that occurs in small groups, where tutors act as facilitators or guides, and where a problem is the focus and stimulus for learning, to stimulate the development of problem solving skills, and where new knowledge is obtained through self-directed learning. Students are encouraged to take responsibility in PBL for the group dynamics in order to organise and direct the learning process with the support from a tutor to enhance content knowledge, and to develop negotiation and communication skills, critical thinking, and collaborative practices.

Conscientization and Problem Based Learning: Tales from the field

> 'The task of the dialogical teacher.... working on the thematic universe.... is to "re-present" that universe to the people from where she or he first received it – and "re-present" it not as a lecture, but as a problem'.
>
> Paulo Freire, Pedagogy of the Oppressed

What follows are four tales taken from classroom practice from students who were attending postgraduate management qualifications, and were in full time employment, in both the private and public sectors. Students in groups were asked to problematize and share through dialogue, topics and problems that were confronting them, (what Freire called "reading circles") so they could explore themes, issues, and their lived reality central to their organisational and professional contexts and experiences. These themes were then decoded, whereby students through their discussions with other group members become more critically aware of their daily problems, so they can gain a greater understanding of their lived reality of the world, and to re-consider how they might deal with their and others' situations, and as a way to mediate, change and deal with the issues that confront them in the workplace. As Ryan (1974, p.36) notes 'In this way, little by little, by means of generative words, they stimulate the creative imagination'. Underpinning this approach was Paulo Freire's participatory action research (PAR) method as a means to facilitate the process of *conscientization* to enable students to problematize and explore their social, political, and cultural contexts, and help them move towards what he called critical consciousness (Freire, 1970, 1972, and 1974). As Montero (2000, p.134) notes, PAR is the key to the practice of liberation and critical consciousness, stating that:

> 'a methodological process and strategy actively incorporating those people and groups affected by a problem, in such a way that they become co-researchers through their action in the different phases and moments of the research carried out to solve a problem'.

The tales illustrate how questioning in reflexive groups (Savin-Baden and Major, 2004) leads students to question how their initial assumptions about their professional realities are challenged through dialogue with their fellow students and their tutor. As Lähteenmäki and Uhlin (2011, p.146) have noted PBL is where:

> 'Everyday learning is an important part of the context and plays a central role in the students' learning alongside organised formal education. In the framework of curriculum design, the learner builds new knowledge on the foundations of all the knowledge he/she possessed before the education began'

Tale 1

One of the challenges facing educators at the beginning of a programme of study is to expose students to issues that go beyond the boundaries of their profession (see, for example, Boyce, 2004 and James, 2006 concerning critical education perspectives). This requires students to move out of their comfort zone and be confronted as to how events beyond their organisational settings affect their professional roles as practitioners. The use of readily available information from the media is an approach that can make an "instant impact" upon students' awareness of how issues impact their professional practice (Armitage, 2010).

Students in small dialogue group choose a current affairs issue of interest from a selection of financial and economic journals provided. They choose an issue of mutual interest and then identify the underlying problem it evokes. They then work individually on this for an hour in order to construct their individual conceptualisation of the problem, before regrouping in to dialogue groups to discuss their perspectives of the problem together in a shared collaborative experience, for example, issue considering its political, cultural and social significance, and what impact it has on their professional and organisational practice. This is summarised and feedback to other peer groups.

This exercise achieves several outcomes. First, it invites students to dialogue in an open, safe environment with each other, an important aspect at the beginning of a programme of study. Second, it shows students there is 'no right answer', but rather a need to justify themselves in the gaze of their peers. This also provides an opportunity for students to become reflective and critical thinkers and illustrates that the ownership of opinions and knowledge is not solely the 'gift of the teacher' or of textbooks. Third, it creates an authentic learning environment via inductive engagement with the world and that it is the understanding of principles rather than a focus upon facts that is important in coming to terms with social, political and cultural meanings of the issues discussed. This suggests that critical reflection and the exposure through dialogue to the multiple contents which subject material is situated fosters critical thinking, curiosity, motivation to learn, and results in a deeper learning experience (Biggs and Moore, 1992; Krause, 2005; Roebuck, 2007).

Tale 2

Teaching is just not the transferring of knowledge it is about questioning personal assumptions, and coming to terms with self-doubt, to make the uncertain certain (Freire, 1970). For students to learn 'how the economy works' requires an approach that not only challenges them to think differently, but also gives them the ability to question how it functions (Armitage, 2010). As Montero (2009, p.80) states 'to problematize is to generate situations in which the people involved are faced to review their actions and opinions about daily life events considered not only as ordinary circumstances, but also as inevitable because of their attributed essential way of life'. Students are asked to evaluate and provide critical feedback on the following questions: What do you understand by interest rates? How does it affect your life? What impact do they have on the economy? What if they rise or fall? What impact do they have on your organisation? What solutions can you provide to make interest rates more socially equitable? This requires the "teacher" to respond to questions from students who are uncertain of this "alien" topic in an open Socratic manner (Armitage, 2010). Students discuss the topic and build knowledge through dialogue between them and the tutor by means of divergent questioning (Biggs and Teng, 2007). A class discussion follows by the use of convergent questioning by 'building from the known' (Biggs and Teng, 2007) as to how the economy works. Students can be quite surprised how close their "naive" thinking coincides with the "official" version as given, for example, in a textbook. This approach

shows students how they can take control of their personal learning journey and reveals also how the economy works through political and cultural historical contexts, and the competing values and interests of society, commerce, and industry.

Tale 3

For Human Resource Management student's ethics appears to be a straightforward subject, being seen as a utilitarian set of principles that are couched in policies and regulation. Instead of presenting them with a text book definition of ethics, a real life case study is given to students so they can problematize the ethical dilemmas it contains, and so they can grapple with the issues that have meaning to them without having to first grasp any associated terminology (Armitage, 2010). They are divided into three groups. Two of the groups are then given one of the following motions, which they are asked to defend: Ethics has no place in and HRM practices; Ethics is central to HRM practice. The third group acts as the audience. The two groups are then asked to discuss and debate for an hour in their groups the motion allocated to them before being asked to present their defence in a class debate. Three people from each of the debating groups are selected to give a five minute defence in turn of their allocated motion. The third group, the audience, are asked to debate both motions prior to the class debate in preparation to ask questions to each of the two debating groups after they have presented their arguments. The tutor's role is to act as the chair, time keeper, to listen, and observe interactions in preparation for their summary of proceedings in a plenary session after the debate, in order to attain what Schmidt and Moust (2000, p.43) term "cognitive congruence" whereby the tutor is able to express themselves in terms of their of students' understanding, this they claim being an important part of PBL, stating that:

> 'If a tutor is not able to frame his or her contribution in a language that is adapted to the level of understanding of the subject matter being studied, these contributions will go unnoticed. In addition, cognitive congruence assumes sensitivity of the tutor concerning the difficulties of students may come across while dealing with a problem or with subject matter relevant to that problem'.

The discussions can be robust and produces a learning environment contextualised within their professional experience and leads them to question: What happens if ethical values conflict with legal requirements? What happens if my personal values clash with the organisation? How would I handle this in my workplace? What emerge from the debate are issues concerning duty, responsibility and moral relativism, legalism versus morality, cultural dysfunction, bullying, and human character. The group presentation and feedback produces further discussion as competing perspectives enter the debate. Whilst these might appear to be "obvious" outcomes, it is important to realise how students have discovered these issues by their own reasoning through dialogical exchanges prior to them being introduced to ethical theories. The interaction between students is central to the creation of new understandings,

and to develop 'clear and compelling ethical positions' and create 'feelings of obligation on the part of others' (Water, 1988:179).

Tale 4

The example described here used a combination of images and dialogue groups together with the participatory visual methods of Vince and Warren (2012) and Sullivan's (2005, p.215) framework of "Visual Knowing" where 'information is encountered, and critiqued to create representations that assist further inquiry' in preparation for studying their organisations and producing clearly structured questions for further investigation. As Barrett *et a*l (2004, p.18) note designing high quality problems is 'a key success factor for PBL' as this provides the 'starting point and the driving force for learning'. Students were invited to consider a single question posed by the tutor: What is your organisation like? Students were asked to produce picture images of how they felt or perceived their organisational reality, and then present them to each other in dialogue groups of 4 to 6 fellow students (see, for example, Armitage, 2012). This approach gave student's freedom to interpret and problematize the question using their personal experiences before 'Responding to information in an insightful fashion through constructive dialogue [where] private views need to enter into public discourse, for it is within the interpretive community of the field that alternative visions are most keenly felt' (Sullivan, 2005, p.215). This allowed them to reveal hidden (suppressed?) feelings of the silent culture of their organisation (see, for example, Freire, 1972), as one student stated:

> 'This process is a cathartic experience – I have never thought of my organisation in terms of image work. Discovering who holds power and who "holds all the cards" in my organisation is something I do not consciously think about in the hurly-burly of my busy day.

Some students' "secret views" and emotional reactions were also articulated not only through their images, but also in how they described this to other students in their dialogue groups. For example, one student drew an image of their organisation in the form of a crucifix, and when asked why by a member of her dialogue group replied:

> 'This is how I feel – nailed to a cross, mocked, and left for dead. It's a kind of slow death as the organisation first suffocates, and then sacrifices those who do not have any form of hitting back, or are not empowered to think for themselves. For me to represent my organisation like this is quite shocking to me as I am seeing the organisation through an emotional lens'

For other students, producing an image picture was a liberating experience, providing an opportunity of free expression. One student, who worked in the public sector, drew an image of a two-lane racetrack as representing their organisation, and when asked what this represented by a member of his dialogue group replied that:

> 'It's the old meeting the new - you know, where the workforce is running at different speeds. Some staff are just there for the money, until they retire, sitting in dead man's shoes so to speak – their pension is their reason to exist. Others, the younger members of staff are those who want change – they have all the ideas, the innovative projects'

The concept of an organisation as creating a "brick wall" also featured in one of the images. This student, who worked in the National Health Service, when asked about her image, conceived her working environment as being one that stopped new ideas from rising to the top – a brick wall separated the management from the "rest":

> 'It's so frustrating - the managers sit behind this brick wall, make decisions, and throw out commands, issue new procedures, and rules, and the meetings they attend, well it's all blah, blah, blah. They can't see the chaos they have created below them; in fact I don't think they care".

IMPLICATIONS FOR PROBLEM BASED LEARNING

Dialogue, as described in the forgoing tales from the field is central to the learning process, and requires a PBL pedagogy that challenges students to reflect, and become reflexive of the power relations underpinning the social context they inhabit as students, and as practitioners. As Barrett and Moore (2011, p.119) note:

> 'We argue that the principle of creating more democratic social relations is a fundamental prerequisite to dialogic knowing. Democratic social relations mean that there is a level of respect, openness, reciprocity, and equality that facilitates students to actively listen to other students' idea and to express their own freely'.

Barrett and Moore (2011, p. 119) note that a barrier to dialogic knowing is authoritarianism, where 'one person dominates, sets the agenda, and makes decisions', and argue that that PBL decentres tutors from their dominant and powerful position in the learning process, and 'moves students away from the passivity and disempowerment to which a power imbalance can give rise', and as Valentin (2007, p.179) notes 'creating dialogue calls for an active role on behalf of the tutor: mediation, posing problems, encouraging participation'. As illustrated in the forgoing tales from the field PBL cannot be taught from a "text book", and has to adopt what Marx (Easton and Guddat, 1962, p.212) advocated as a 'relentless criticism of all existing conditions, relentless in the sense that the criticism is not afraid of its own findings and just as little afraid of conflict with the powers that be' in its quest for a pedagogy that engenders integrity in the learning process, an approach advocated by bell hooks (2010, p.21) as an engaged pedagogy that:

> 'emphasises mutual participation because it is the movement of ideas, exchanged between everyone in the classroom. This process helps establish the integrity of the teacher, while simultaneously encouraging students to work with integrity'.

This it can be argued is critical for PBL group dynamics and requires tutors to create spaces for critical enquiry and reflection if they are to include and make better use of students' experiences and competencies that they bring to the learning process. As Valentin (2007) argues group processes and their dynamics in the early stages of a learning programme are essential to a learners understanding and Dehler *et al* (2001) advocate for the reversing of the teacher-student relationship where students are encouraged to take responsibility for their own learning. It is therefore suggested that if PBL environments are to embrace the principles of *conscientization* and dialogical learning approaches then the '*Ten Principles of Critical Learning'* of Armitage (2010) might be adopted as a set of guiding principles for reflective and reflexive practices at the beginning of educational programmes as follows:

> **Principle 1:** Learning and teaching is not merely the transference of knowledge.
> **Principle 2:** Learning requires respect, dignity and equity of treatment of students towards fellow students, tutor towards students and students towards tutor.
> **Principle 3:** Learning requires we take control and responsibility for our personal learning journey.
> **Principle 4:** Learning requires we create knowledge together through critical discourse and dialogue.
> **Principle 5:** Learning requires that we discover how the world works; it is not merely the acquisition of facts.
> **Principle 6:** Learning requires transparency, accountability and justification of our opinions before our peers.
> **Principle 7:** Learning requires we develop and build relationships through shared understandings by creating a learning community founded on mutual trust and dialogue.
> **Principle 8:** Learning to be authentic requires immediacy and relevance to our political, social and cultural contexts.
> **Principle 9:** Learning requires the provision of a safe learning environment is fundamental in making us aware of our and others' feelings and emotions.
> **Principle 10:** Learning requires we learn to listen, suspend our prejudices and not pre-judge others.

CONCLUSION

Problem Based Learning is an approach that requires both the tutor and the student to become *conscientizised* in the transformational dialogue of their socio-historical-political worlds of *self* and *other,* as Gustavsen (2006:19) notes 'All participants have the same status in the

dialogic arena'. This requires a reflexive turn that is located within the social context of PBL practices and the power relations underpinning the personal relationships they are enacted within. Problem Based Learning is not just the collection of facts and figures that are to be submitted to analysis using pre-determined methods and procedures, but rather demands that both tutors and students to submit themselves to a process whereby they acquire new knowledge through the dialogical process. If new imaginative awakenings are to be sought, and embodied within PBL practices, then its focus needs to reach beyond the confines of problem solving and the acquisition of professional skills. The process of *conscientization* as the foundation where students can challenge and re-construct their personal and professional practices, and assumptions must be embedded within a PBL pedagogy. This will enable students to be better prepared to meet the complexities of their professional roles, not only as a means to help them be better problem solvers, but also as moral agents and decision makers situated in their political, social, and cultural realities.

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Journal of Problem Based Learning in Higher Education

VOL. 1, No. 1, 2013 – Page 19-35

PBL in Educational Psychology – Potentials and Challenges

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ABSTRACT

This article discusses practical and theoretical aspects related to PBL. In the first section of the article, potentials related to professional training of forthcoming educational psychologists following PBL-principles are analyzed. It is argued that PBL constitutes a good platform for creating stimulating interplays between theory and practice. In the second section of the article we discuss some of the theoretical underpinnings in PBL. We discuss whether PBL is prone to a 'form-content-dualism', in which attention is centred on the form (the problem) and less on the content of learning. Afterwards, it is discussed whether PBL potentially leads to an individualization of the learning process. Finally, we discuss whether the PBL-literature primarily tends toward portraying student learning as a matter of acquisition of knowledge, and therefore ignores the ontogical and identity-related processes in learning.

SECTION 1: PROBLEM BASED LEARNING

Problem-based approaches to learning have a long history that at least can be dated back to John Dewey's (1938) work on the relation between experience and learning/education. PBL is thus part of a tradition in which the importance of meaningful and experiential learning is highlighted. Other than the theoretical background in Dewey, PBL is inspired by as different theoretical approaches to learning as the theories of Piaget, Lewin, Negt, Vygotsky, Kolb, Lave & Wenger, Illeris (Kolmos et al., 2004). Although these approaches have different theoretical roots, they all highlight how learning is an active process and how the gaining of experience is an important part of the learning process. Despite the somewhat different

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theoretical roots, PBL in its various forms, thus seems to highlight learning as a student centred activity (Norman & Schmidt, 1992; Fox, 2001; Coffin, 2011).
PBL is a way of teaching in which students learn through facilitated problem solving, and according to most notions of PBL, learning is most fundamentally about providing students with an active role in the acquisition and production of knowledge. In PBL, student learning is centred on the solving of a complex problem that usually does not have single answer (Hmelo-Silver, 2004).

There has been conducted a lot of research on the role of the problem in PBL. Some of the general findings from this research is that a problem should: (1) be authentic; (2) be adapted to student's level of prior knowledge; (3) engage students in discussions; (4) lead to the identification of appropriate learning issues; (5) stimulate self-directed learning and (6) be interesting and relevant (Schmidt et al., 2011: 795).

From being an alternative approach to teaching and learning, PBL has become increasingly popular, and is nowadays used in numerous variants on almost all educational levels and fields (Laursen, 2004). The widespread distribution of PBL also means that PBL can take different forms according to the specific educational contexts, but there still seems to be some common goals or aims in the problem-based curricula. According to Hmelo-Silver (2004: 239-40) these goals aim at students:

1. constructing an extensive and flexible knowledge base;
2. developing effective problem-solving and metacognitive skills;
3. developing self-directed, lifelong learning skills;
4. becoming effective collaborators; and
5. becoming intrinsically motivated to learn.

Ad 1. Basically, the goal of all learning curricula is to have students create an extensive and flexible knowledge base. But the path leading to this goal can take various forms. In PBL, an ongoing discussion is: How much knowledge is needed to formulate or construct a 'good' problem?

If the concept of PBL is taken literally, then learning should always take its starting point in a theoretical or practical problem. But a literal interpretation might lead to a rigid ideology in which all learning - no matter what – starts with a problem. In this context, Christensen's (2004: 94) question: "*Should a 'good' learning process always start with a problem*?" becomes relevant. It could be argued that a prerequisite for working constructively with a problem is a basic knowledge base. So instead of a rigid ideology in which all learning takes its starting point in a problem, the central tenet in PBL is that the construction of extensive competencies goes beyond having students learn the facts of a single domain. Instead student learning should be relevant such that it reflects or exemplifies relevant societal, material and

social structures, which usually involves integrating information across multiple domains and working with exemplary topics and problems.

Ad 2. In PBL, the development of relevant competences includes the ability to apply appropriate metacognitive and reasoning strategies (Hmelo-Silver, 2004). Metacognitive skills are usually conceptualized as an interrelated set of competencies for learning and thinking and include many of the skills required for critical thinking, problem solving, reflective judgment and decision-making. Metacognitive skills further refer to the planning of one's problem solving, and to the evaluation of whether one's goals have been achieved. In other words, the development of metacognitive skills is the process in which students learn to learn.

Ad 3. An important goal in PBL is that students take responsibility for their own learning processes. The PBL-literature advocates that the development of students' self-directed learning can be used to enhance content knowledge and foster problem-solving, communication and critical thinking skills (Ibid.). Schmidt et al. (2011) also refer to research that indicates that students in PBL-learning settings become more self-directed as the years of study progress compared to students who are not in a PBL-curriculum which is often associated with students getting trained at creating solutions to real-world-problems.

Ad 4. Becoming effective collaborators implies knowing how to function well as part of a team. In most PBL-settings, students collaborate in small groups. The benefits of small-group collaboration have been discussed extensively in the PBL-literature (Schmidt et al., 2011). The research indicates that (1) small groups provide a platform for the development of friendships among students; (2) allows for closer contact between teacher and students compared with those possible in a larger class, (3) the regular meetings in project groups motivate students to be diligent in their self-study and to meet the deadlines for work agreed by the group and (4) that students in small groups collaboratively construct a more distributed knowledge base (Ibid.; Ryberg et al., 2010).

The general benefits of engaging in small project groups also have been found to prevent drop-out and might be a reason why students in PBL-curricula graduate at a faster rate compared to students at conventional schools (Ibid.).

The fact that PBL-students become effective collaborators also tends to be highlighted as an appreciated asset when students after graduation apply for jobs.

Ad 5. Finally, an important aim of PBL is that students become intrinsically motivated, meaning that learners work on a task motivated by interests in the learning-topic (Hmelo-Silver, 2004) rather than extrinsic motives as examinations and marks.

PBL holds as a premise that solving theoretical or practical problems is more motivating than engaging in a traditional scholastic learning process. But to be motivating, the problems should provide students with the possibility of applying their knowledge in an appropriate, stimulating and productive fashion. In other words, the character of the problem is supposedly a factor that mediates students' motivation for learning in PBL-curricula.

The abovementioned PBL-characteristics do clearly not capture all understandings and definitions of PBL. De Graaff & Kolmos (2004) describe how many attempts have been made to define the concept of problem based learning and that the actual design of PBL varies considerably from institution to institution. As described, PBL is inspired by as different theoretical traditions as Piaget's constructivism and Lave & Wenger's sociocultural notions of learning. As a consequence, the field of PBL is marked by quite different pedagogical approaches. Our purpose is not to argue in favour of one specific interpretation of PBL. However, throughout the article we tend to criticize notions of PBL that clearly are inspired by an individualistic ontology.

In the following section, we will describe a PBL-based educational program for educational psychologists. On the basis of the description of the program, we will discuss some general aspects related to PBL.

EPSW – EDUCATIONAL PSYCHOLOGY IN SOCIAL WORK.

In the following, we will describe a PBL-based MA-training program for educational psychologists at Aalborg University. Aalborg University was inaugurated in 1974. From the beginning, the problem-based and project-organized teaching (PBL) was part of the university's pedagogical profile. While being innovative the educational strategy at Aalborg University was met with widespread skepticism from the other Danish Universities (Caspersen, 2004). However, the PBL-model became gradually acknowledged. This acknowledgement came from two sides. Firstly, graduate students from Aalborg University (and Roskilde University who also works according to the PBL-principles) were and still are well-received on the labour market. Secondly, the PBL-model has been supported by empirical studies that have documented how PBL affects learning (Norman & Schmidt, 1992; Schmidt et al., 2011).

While Aalborg University still practices PBL, the general status of PBL is that it nowadays is used in numerous variants on almost all educational levels and fields. The widespread distribution of PBL has also contributed to a development of the educational philosophy in PBL.

In the remainder of the article, a PBL-based master degree program for educational psychologists is presented. On the basis of the specific educational program, general aspects regarding PBL are discussed.

Educational Psychology in Social Work (EPSW) is a master degree program at the Department of Communication and Psychology at Aalborg University. EPSW aims at qualifying students for future work as educational psychologists or in social work. The program stretches over 4 semesters and is organized partly in relation to curriculum, partly in relation to tasks and cases collected from social institutions in the nearby area and at a nearby Educational Psycology Service center (EPS).

There are approximately 20-25 students at EPSW each year, and they all have a bachelor degree in psychology.

In the introductory part of the program, the students participate in different workshops in which basic educational psychology methodologies like supervision, testing, coaching and interview techniques are taught. Afterwards, the students are organized in groups of two. Each group gets an authentic case collected from a range of social institutions mainly for residential care for residents with special needs – that is learning disabled, people diagnosed with infantile autism or other pervasive developmental disorders etc. The institutions typically ask for assistance that for example could consist of psychological assessment of a resident in order to qualify their professional work. The students work on these cases with supervision from experienced psychologists and end up writing a report to the institutions.

During this work, all the students at EPSW meet at weekly seminars with two teachers at the university. At these seminars the different groups report on their experiences from the cases. The groups for example reflect on specific problems mentioned by the staff at the institutions, the acts and attitudes of the staff, aspects of the assessed person, the cooperation with the institutions, different interests in the result of their assessments, limits of (their) psychological expertise etc. These topics are discussed partly for supporting the students, while they are engaged in their cases, and partly for relating to theoretical themes and the curriculum at EPSW.

The seminars are thought of as a forum where the students at EPSW can discuss their practical experiences in relation to theory. At the same time, the seminars also contribute to the development of a collaborative team-feeling among the students where they are trained at supporting each other, and in developing their professional competencies, professional identities and personal standpoints while working on their cases. During the seminars, the students are encouraged and expected to engage in and comment on each other's cases. They also experience two teachers who do not always agree during the discussions, which support them in developing their own professional standpoints.

After completing their work on the cases at the social institutions, each group consisting of two students are matched with an educational psychologist from the local Educational Psychological Service-center (EPS). Once again, the students get a case, and they are closely monitored and supervised by the psychologist during their work on the cases. To exemplify, we will shortly describe what such a case typically looks like. Below is an introductory summary of a case that was sent from the EPS to our students:

"L is a 7-year old boy. L. finds it difficult to concentrate and stay focused in class, unless he finds the tasks interesting. In addition, he is impulsive and has a hard time at turn-taking. To his class-mates, he appears somewhat self-willed and he likes doing things his own way. L expresses that he would like to have more contact with his classmates. He is apparently gifted, his vocabulary is good, and he contributes relevantly to conversations. His relationship with teachers is characterized by the fact that he is often being scolded. He also often gets into conflicts with the other children and he finds it difficult to acknowledge his own share in the conflicts. The school has observed that L. has facial tics. L's teachers and his mother ask for an assessment that can determine whether L's behaviour is due to immaturity, or whether there may be other causes that explain L's behavioral patterns."

Like with the students' cases at the social institutions, the students also discuss their cases on weekly seminars at the university. The dialectics between students' practice experiences and the discussions at the seminars are seminal to the PBL-inspired ambition at EPSW of combining authentic psychological problems with a theoretical curriculum.

Currently, educational psychology's field of practice is undergoing what could be termed a paradigmatic shift from an individualized focus on children with problems to a focus on how a systemic, consultative approach extends the possibilities for understanding and acting in relation to problems experienced within schools (Farrell, 2009). The consultative approach to educational psychology practice thus implies working through key adults around the children instead of focusing narrowly on the single child. Another central characteristic of the consultative approach is that the educational psychologist ideally changes from an expert to a process consultant who instead of assessment-based counseling tries to facilitate change through questioning the different practices that the particular child participates in (Farell, 2009).

In the case above, many of the discussions at the seminars at EPSW were related to the paradox that educational psychologists increasingly are expected to work consultatively. Yet, the specific case formulation asked for a non-consultative service delivery by the educational psychologist.

Many of the discussions at the seminars were subsequently based on this specific problematic, and led to questions like:

- Why is a new theoretical concept like the consultative approach difficult to carry out in practice?
- Why do teachers often ask for individual assessments of students?

SECTION 2: DISCUSSION

From our perspective, the PBL-inspiration in EPSW is evident in that the students are dealing with authentic psychological problems as part of their professional training. This way of organizing teaching and learning holds some very interesting educational possibilities. Among others can be mentioned how the students get motivated by the different cases, how their learning gets structured by the cases, how they get prepared for a job after their graduation and thus more easily avoid a practice shock (Stokking et al., 2003) and how they more easily identify with their future role as educational psychologists. Yet, the PBL-elements in EPSW also triggers questions and reflection that put in perspective some general theoretical and practical issues related to PBL, and the aim of the second part of the article is to discuss some of these questions.

Firstly, we will discuss whether PBL – in spirit of the time – is prone to a form-content dualism in which educational practice is concerned with forms of teaching and learning rather than the content of learning.

Secondly, it is discussed whether PBL potentially individualizes student learning.

Finally, we will discuss how the EPSW-students' learning trajectories are characterized by not only the acquisition of psychological skills, but also a professional identity development. It is argued that the identity constituting part of learning is both a valid and meaningful topic in research on PBL.

IS PBL PRONE TO A FORM-CONTENT DUALISM?

When the students on EPSW are dealing with their different cases two by two, they tend to get completely absorbed by the complexity of the cases. They are concerned with questions like: how do we offer the best professional guidance in the case, which professional methodologies and tools should we apply in the case and how do we write a report that communicates our findings and advice?

These are evidently legitimate and relevant professional concerns that stimulate student learning, but there is also a potential backside to the coin. Some of the students get so

involved in the practical questions in their cases that the general theoretical, curricular and exemplary questions are left almost unattended. They tend to narrowly focus on the problems in their cases, and they are thereby increasing the risk of missing the more general and exemplary learning aspects. The dichotomy between the student´s preoccupation with the specific case and practical issues on one hand and exemplary and subject-based theoretical curriculum on the other, at the same time refers to a more general discussion about different tendencies in our educational system. The educational field is constantly being flooded by different methods, technologies and concepts like cooperative learning, learning styles, classroom management, PBL, neuro-pedagogy, brain-based education etc.. Common to these educational concepts is that they tend to promote themselves as having the answers to many of the challenges faced by the educational system (Szulevicz, 2012). Another common characteristic is that the different educational concepts are concerned with *forms* of teaching and learning, rather than considerations on a specific *content*. This potentially leads to a form-content dualism in which possible connections between the form and the didactical content of learning is left unattended (Tanggaard & Brinkmann, 2008). The form-content dualism is for example seen in Björgens (1991) notion of 'responsibility for one's own learning'. Björgen emphasizes how teaching is about fostering responsible students. The aim of teaching thus becomes the development of student responsibility, while less attention is paid on the specific content of student learning (Tanggaard & Brinkmann, 2008).

From our perspective, there are different reasons why it is interesting to discuss whether PBL is prone to such a form-content dualism.

Firstly, a form-content dualism might result in a situation in which the content of a discipline or subject is de-emphasised. Laursen (2004: 67-68) for example points out how various forms of teaching and learning in the project-work in PBL quite often are not functionally integrated. Laursen describes how this tendency is a result of a de-centering of the disciplines because of weak definitions of content in a great part of PBL-teaching. Laursen (2004: 68) also argues that the progression in students' knowledge and competencies generally is too weak, because they often avoid the dull and difficult elements of content. In other words, students tend to avoid difficult theories or subjects when working on their projects. Laursen further draws attention to the fact that many PBL-universities have rather weakly defined contents of studies and few indicators of relevance for the students as points of navigation. This critique has partly been met by introducing more courses with a defined curriculum and with more curriculum-testing exams and in this way describing content as curriculum.

If we once again turn back to EPSW, the students do not choose their practical cases themselves. This also means that the students cannot avoid the difficult aspects in the cases. Likewise, the discussions at the seminars are relating work on the cases to the curriculum of the course, and in this context, an important challenge for the students becomes to demonstrate the exemplary aspects across the cases and hereby combine theory with practice.

Secondly, the form-content dualism can be inexpedient because important didactical and educational questions are reduced to a matter of technique or methodology, which potentially leads to a standardization or manualization of teaching and learning practices. Holst (2010) for example argues that teachers tend to teach in a more standardized and less reflective way when teaching according to a specific technology or concept. But although PBL might not be a concept that standardizes teaching or learning, it still could be termed a 'form-pedagogy' if the learning process necessarily has to start with a problem, or if it focuses on the specific problematic instead of the exemplary dynamic that the problem represents. Inherent in this form is also a potentially rigid standardization of the teaching and learning process. As previously described, Christensen (2004) for example argues that a rigid interpretation of PBL would be to assume that all learning processes should start with a problem, followed by an analysis of the problem, and finally a search for a solution to the problem. Depending on the content of the subject to be learned, the learning process could have another starting point than a problem. If PBL is interpreted too rigidly, Christensen argues that it loses its function as a corrective to practice and instead just becomes a buzz word.

At EPSW, the process is different for different groups depending on their cases so there is no standardized way of working with their problems and at the seminars these different procedures can be reflected upon. The task of combining theory with the practical problems in a way which enriches the understanding of the practical problem is a common task for both students and teachers, who share the responsibility of avoiding dualities of form-content and theory-practice.

Thirdly, the form-content dualism tends to focus more on *how* students learn than on *what* they learn. This point is not necessarily a critique, but rather a reflection on which parts of the learning process that are being emphasized. PBL and other present day learning traditions that more or less draw on constructivist thinking attach great importance to the concept of metacognition in which students are supposed to consciously set the targets for their learning, choose the paths they wish to follow, and evaluate the results of their learning (Kivinen & Ristelä, 2003). As described previously, PBL is inspired by Dewey's work on the relation between experience and learning, but according to Kivinen & Ristelä (2003: 270), the notion of metacognition goes against Dewey's understanding of learning. Dewey emphasized how learning occurs while the pupils are not aware that they are studying. Instead learning occurs because students concentrate on the content of learning or the subject matter they are studying. So, according to Kivinen & Ristela, notions of learning that emphasize the importance of metacognition actually misrepresent or at least have a different conception of the learning process than Dewey's pragmatist notion of learning. Kivinen & Ristela (2003: 371) summarize their critique of the notion of metacognition as follows:

> *"Practices encouraging the observation of one's own learning as an end in itself can basically be seen as a mere rejustification of testing that has traditionally ruled school activities. Instead of the pupils being taught new skills and knowledge, they are trained to monitor their own studies. A gradual improvement in the ability to work independently is quite rightly an aim for education, but it is by no means self-evident that this can be achieved or promoted by intensive concentration on the operative aspects of one's own thinking."*

Kivinen & Ristela argue that the desired development of student metacognition potentially leads to a psychologization of the learning process in which students reflect upon their own actions and where they are taught to contemplate their own learning, knowledge and skills (Ibid.).

To summarize, our point is not to downplay the importance of the fact that students in higher education learn to learn. Rather, our point is that a strong emphasis on metacognition potentially leads to 'a psychologization of the learning process'. This psychologization has as a potential backside, that the students are taught to contemplate the supposed inner operations of their own learning (form), rather than skillfully practicing the content of the discipline.

DOES PBL INDIVIDUALIZE STUDENT'S LEARNING?

The seminars on EPSW are based on a democratic principle that all groups once every two weeks at the seminars present their cases. This is a rather time-consuming, but nonetheless important part of EPSW, because links and discussions between curriculum and practice are made on the basis of the students' presentations. Usually, the students are very engaged in each other's cases, but some students get so enthusiastic about their own cases that they do not engage in their peer's projects. The lack of engagement in peer's projects is problematic because it threatens the mutual dependency between students, but the lack of engagement is also inexpedient, because an important part of the learning process at EPSW is to discuss and draw attention to the exemplarity and general aspects related to the specific cases.

Again, this observation points to some general PBL-related aspects. Although a great part of student learning takes place in groups and thus is socially distributed, PBL might still potentially enhance individualization of students' learning. Laursen (2004: 68) for example argues:

> *"The individual learning processes are to be supported by "theory-enriched" and problem oriented dialogues integrated in the project work. These dialogues are partly taking place between the students. Unfortunately these dialogues often are time-consuming, difficult to establish and maintain, and although these dialogues play a crucial role for the development of meta cognitive competencies, the student's motivation to take part in them are generally weak."*

From Laursen's perspective, students are either not sufficiently motivated to engage in dialogues, or they primarily want to engage in discussions concerning their own projects. This is especially important in a PBL-learning setting like EPSW, where the groups only have two members. In this context, mutual involvement between students and towards their different projects thus becomes an important prerequisite for a good PBL-learning environment. Following Kraft & Nielsen (2006), such mutual involvement can be difficult to obtain in understandings of learning that emphasize students' individual experiences. According to Kraft & Nielsen, individualization of the learning process is often a consequence in pedagogies that have individual experiences or individually defined problems as a starting point for the learning process. Kraft & Nielsen argue that such notions of learning are rooted in a humanistic psychological understanding, in which education and teaching are about realizing students' selves and inner potentials (Ibid). In most cases, learning in PBL-settings namely starts with students defining a problem. Following Kraft & Nielsen, PBL can thus lead to an individualization of the learning process in which students focus too narrowly on their individually defined problems. However, it is definitely debatable whether PBL leads to individualization. For example, most versions of PBL emphasize that problems should be exemplary (Barge 2010). This exemplarity ideally prevents students from working on too narrowly defined problems. Yet, the notion of solidarity does not necessarily prevent the students from only engaging in discussions concerning their own work.

If we turn to EPSW, the students do not choose their own cases. Instead, the cases are authentic cases from the cooperating institutions and the local EPS that are randomly distributed amongst the students. The students are expected to solve the problems that they encounter while working on the cases, and the teaching at the seminars connected to this work aims both at helping the students solving these cases, but equally important, the teaching also draws attention to the general and curricular aspects of the cases. The challenge is to get the students involved in these general discussions and not just in their specific cases. If they engage in these common discussions at the seminars and see parallels across the cases, they profit from their peer's experiences and a mutual responsibility can evolve. During these seminars the task of the teachers is to constantly shift between discussions of concrete cases and of exemplary and curricular aspects of these concrete cases. In order to avoid the discussed possible individualization in PBL, the seminars are thus instrumental, because they constitute a platform, where the exemplary aspects of problems and cases are highlighted and discussed in relation to curriculum. On these seminars the teachers play an important role in

constantly challenging students' understanding of the content and constantly addressing the exemplarity of the cases.

DOES PBL-LITERATURE OVERLOOK HOW LEARNING IS AN IDENTITY CONSTITUTING PROCESS?

Many studies have compared PBL to traditional programs. The large variation in PBL-practices makes the analysis of PBL's effectiveness difficult. Yet, there is a general lack of convincing research that extensively documents its effectiveness (Norman & Schmidt, 1992; Vernon & Blake, 1993; Wood, 2003). However, a generally accepted finding that emerges from the literature is that PBL produces positive student attitudes (Prince, 2004). From our perspective, the relation between identity development and learning is particularly strong in PBL compared to many other ways of organizing learning environments in higher education. Yet, this relation seems to go rather unnoticed in great parts of the PBL-literature.

One of the most striking aspects related to teaching on EPSW is the professional development that the students go through during the semesters on the program. When the cases are handed out to the students at the beginning of the program, almost all of them react with fear, nervousness and feelings of inadequacy, but three semesters later at the end of EPSW, they feel prepared for a job as psychologists in an EPS. This transformation bears witness to the fact that the students have acquired the needed professional skills to act as educational psychologists. But the transformation also testifies to an impressive growth of identity. It is our claim that this relation between learning and identity formation is very important, but also that it is a rather uncharted territory in the PBL-literature. (However, for example Ryberg, 2007 has treated the relation between identity and learning in PBL). It is important to make clear that while much psychological research treats identity as a static self-concept, we address identity as fluid, dynamic and closely linked to participation in learning communities (Lave & Wenger, 1991; Wortham, 2006). Previously, we discussed whether some parts of PBL could lead to an inexpedient individualization of learning. In this context, it could be objected that our focus on identity formation also individualizes student learning. This is truly a valid objection, but from our perspective Lave & Wenger's notion of identity is so to speak social. From a situated learning perspective, learning is viewed as progress along trajectories of participation and growth of identity (Lave & Wenger, 1991) where participants start as legitimate peripheral and end up as fully fledged members. Methods of instruction are not only instruments for acquiring skills; they are also practices in which students learn to participate in different and often paradigmatic ways (Wenger, 1998). The situated learning perspective thus highlights how learning entails transformation of persons. But this transformation can only take place while the learner participates in socially situated and distributed communities of practice. The understanding of identity formation from a situated learning perspective is thus non-individualist and non-dualistic and focuses on the learning person's participation in communities of practice (Lave & Wenger, 1991).

According to Packer & Goicoechea (2000), the situated learning perspective's emphasis on identity formation in learning also sheds light on how learning is not only an epistemological, but also an ontological practice. In this context, epistemology refers to the systematic of knowing: which kind of knowledge counts as valid and what counts as truth e.g.? Ontology is the consideration of being: what does it mean to be, what is, what exists e.g.?

According to Packer & Goicoechea (2000), ontological assumptions in theories of learning often go unnoticed. Instead, learning is mainly conceptualized epistemologically in terms of changes in knowing. This is for example the case in many constructivist theories of learning where learning is understood as construction and qualitative reorganization of knowledge structures.

In some parts of the PBL-literature, learning is also mainly depicted from epistemological assumptions. Schmidt (2011: 793) for example describes:

> *"In PBL, learners are presented with a problem in order to activate their prior knowledge. This prior knowledge is then built upon further as the learners collaborate in small groups to construct a theory or proposed mental model to explain the problem in terms of its underlying causal structure."*

Another example of the epistemological emphasis in PBL-learning theories is found in Coffin's (2011: 18) description:

> *"(…) all PBL curricula are designed on the basis of the learning theory of constructivism where students construct knowledge for themselves."*

In both quotes above, the relationship between the learner and the environment is taken to be an epistemological one: learning is a matter of the subject coming to better know the world (Lave & Packer, 2008).

Generally speaking, the widespread neglect of ontology in learning theories might lead to a narrow conception of learning, in which learning gets reduced to an individualistic, mental or cognitive activity, and where Lave & Wenger's (1991) notion that learning involves the construction of identities tends to go more or less unnoticed. From a situated learning perspective, learning is a socially situated activity grounded in a social ontology that conceives of the person as an active being. Learners participate in identity-generating activities, and from this perspective, learning is not only a matter of coming to know the world better, but also a process of coming to be (Packer & Goicoechea, 2000). The overall point is that learning both comprises epistemological and ontological aspects, but that the ontological aspects related to learning often go unnoticed.

At EPSW, the students participate in an ongoing and authentic professional educational psychology practice, and hereby participate in identity-generating activities. Learning at EPSW is thus a transformational process that involves aspects of professional identity formation. This is facilitated by two teachers being present and showing different standpoints from time to time, and by creating an atmosphere of open discussions with no one-and-only answer to these. The students are encouraged to make their own opinion on the aspects of professional knowledge and practice debated at the seminars, and this is done in a mutual discussion. In line with Packer & Goicoechea (2000), the student's learning can be seen as both including epistemological and ontological aspects. At ESPW these aspects involve the acquisition and development of professional techniques (supervision skills, interview skills, testing skills etc.), but also the formation of a professional identity through the common experiences at the seminars.

We want to emphasize ontology (identity formation) as a valid and meaningful topic in research on PBL. On EPSW, the student's identity transformations are fairly evident. But it is our contention that identity formation and transformation generally are related to all learning processes. It is even our hypothesis that the identity-formation process is particularly strong in PBL-learning settings and could be emphasized as one of the reasons why PBL-students graduate at a faster rate compared to students at conventional schools (Schmidt et al., 2011). The group-based project work is often mentioned as an important contributor to the positive learning environment in PBL-settings (Ibid.). Yet, Schmidt et al. (2011) mainly describe the benefits of collaborative learning in epistemological terms:

> *"It seems that elaboration in a small group not only facilitates the processing of a study text, but also adds to its longerterm memorability." (Schmidt et al., 2011:794)*

In the same vein, Hmelo-Silver (2004: 246) describes:

> *"One assumption of PBL is that the small group structure helps distribute the cognitive load among the members of the group."*

In these quotes, the groups are presented as ways of organizing student collaboration that enhance individual learning. But the learning processes are mainly described as mentalist or cognitive activities. Likewise, when the social benefits of team work in PBL are pointed out, they are mainly framed in an instrumental way as platforms for developing friendships, platforms for closer contacts between teachers and students or simply as a more motivating way of organizing student learning (Norman et al., 1992; Schmidt et al., 2011). However, from our perspective PBL-environment and student participation in groups have an important

ontological or identity-constituting dimension. In the quote below, Packer & Goicoechea describe how school has a fundamentally relational and cultural character:

> *"School has a relational and cultural character without which problem solving, skill acquisition and intellectual inquiry would not occur, and which makes it the site of a search, sometimes a struggle, for identity. When this is ignored we do not adequately understand either the social or the cognitive aspects of schooling, and we cannot grasp the way schools transform children into adults who will live and work in a complex modern society."* (Packer & Goicoechea, 2000: 239).

If we fully want to grasp learning in PBL we also have to focus on the relational and cultural character (ontological aspects) of the learning environment in PBL. Some of these important relational characteristics are that PBL-students get the chance to frame their learning in relation to self-defined and real world-problems, and that they further collaborate with peers solving these problems. Altogether, this makes up an involving, motivating, transformational and thus identity-constituting way of learning.

CONCLUSION

In the article, we have described a PBL-based MA-training program in educational psychology. We have described how PBL holds some very interesting educational potential. Among others can be mentioned how students get motivated by working with real-life problems, how their learning gets structured by solving real-world problems, how they get prepared for a job after their graduation and thus more easily avoid a practice shock and how they more easily identify with their future role as educational psychologists.

From our perspective, it is important to uphold the core values that make PBL an alternative to more conventional ways of organizing learning. Yet, we still have to be aware of the challenges related to PBL – some of which are discussed in the article.

We have argued that PBL – in some forms – can be prone to a form-content dualism in which attention is centred on the form (the problem) and less on the content of learning.

We have also discussed how PBL potentially individualizes student learning. Finally, we have discussed how identity-constitution can be very strong in PBL-learning. Yet, PBL-literature tends to ignore these important identity-constituting aspects of the learning process. We have argued that relation between identity and learning should be a valid and meaningful topic in research on PBL.

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Producing and scrounging during Problem Based Learning

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ABSTRACT

When problem based learning occurs in a social context it is open to a common social behaviour, scrounging. In the animal behaviour literature, scroungers do not attempt to find resources themselves but rather exploit resources found by other group members (referred to as producers). We know from studies of animal behaviour (including humans) that scrounging can be expected whenever animals exploit resources in groups. We also know that scrounging can have deleterious effects on the group. We can expect scrounging to occur during social learning because the exchange of information (which I will consider here as a resource) is essential to social learning. This exchange can be seen as each individual scrounging from the other members of the group whenever the individual learns from the work of others. However, there is a danger if some individuals learn mostly through their own efforts while others indulge in "social loafing" relying heavily on colleagues to provide knowledge. Here I propose that game theory models developed to analyse feeding in animal societies may also apply to social learning. We know from studies of birds feeding in groups that scrounging behaviour depends on the extent to which resources can be shared. Further, when scrounging is prevalent groups tend to obtain fewer resources. By contrast, in social learning we attempt to facilitate sharing of knowledge. We thus encourage scrounging and run the risk of reducing learning within study groups. Here I analyse the role of scrounging in problem based learning. I argue that scrounging is inherent and necessary to any social learning process. However, it can have perverse effects if the acquisition of facts rather than understanding comes to dominate learning objectives. Further, disparities among individuals within a group can lead certain individuals to specialise in scrounging thus undermining the functioning of the group. I suggest that motivation, problem structure, discussion group dynamics, attention to results expected from students

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and careful evaluation can be used to encourage scrounging as a cooperative tactic while minimising its negative impacts on group performance.

Keywords: Scrounging, social learning, motivation, objectives, group size, evaluation

INTRODUCTION

Although problem-based learning (PBL) can involve just a single student (Woods 1994) it is commonly used in a social context. Usually a group of students is given a problem which they must analyse, evaluate and understand together. Understanding the problem will lead the students to learn something new. The learning process will always involve both individual and group activities. Here I will assume a PBL model like the one used at the Université du Québec à Montréal (Mauffette and Poliquin, 1997) based on the Schmidt's (1983) 7 jump model. I expect that the phenomena I describe here will apply to many PBL formats. Working in a group students must analyse problems and fix clear objectives about what they must do in order to address the problem they have been given. Individually each must search for the knowledge necessary to meet the group's objectives. Finally, the group must assemble their acquired knowledge in order to understand, and perhaps solve, the problem they have been given. This final phase usually involves a group discussion which I will call a tutorial.

We expect learning to occur throughout this PBL process in both the individual and group phases. The individual phase is important because, ultimately, it is the individual student who must learn. The tutorial, group phase, allows each student to compare knowledge with that of colleagues, to validate personal understanding of the concepts being studied, to critique and correct personal understanding and that of others, to form a synthesis of what has been learned and to consolidate this learning around the concrete example provided by the problem under study.

Both individual and group phases of this activity are essential to understanding the problem at hand and to assimilating the concepts necessary to this understanding. Without the tutorial students will be deprived of the opportunity to compare and contrast their understanding with others and will have less chance to synthesize their knowledge to obtain a deep understanding of the concepts under study. Without the individual phase of the process, groups will have nothing new to discuss and will be limited to sharing what knowledge they had prior to encountering the problem.

In an ideal world all students would thus invest time in individual study in order to develop a good understanding of the problem to bring to the tutorial. However, in reality, students must manage their time among a number of activities of which studying

(working on the current problem) is just one. They are thus likely to develop strategies to help them succeed in their studies despite their time constraints. One possible strategy is to minimize time spent on individual study and to rely heavily on the contribution of others during tutorials in order to understand a given problem. My objective is to discuss the likelihood and consequences of this strategy both for individuals who adopt it and for others in their study group. I will base my discussion on studies of the "Producer-Scrounger Game" in the field of animal behaviour (Barnard &Sibly 1981, Vickery *et al.* 1991, Giraldeau& Dubois 2008).

PRODUCING, SCROUNGING AND LEARNING IN GROUPS

Analysis of producing and scrounging among animals is based on the theory of games (von Neumann and Morgenstern, 1944). Originally a mathematical tool developed by economists, the theory of games can be used to predict the best choice of behaviour of an individual when the success of the behaviour depends on the behaviour of others. The theory evaluates not just the best choice of one individual but also the best choice of each individual faced with the prospect of interacting with others who are also attempting to choose their own individual best behaviour. This approach is been widely used in studies of animal behaviour since the publication of Maynard Smith's book in 1982.Here we will draw a parallel between a well-studied game (producing and scrounging) and learning in groups.

Animals often use the behaviour of others to locate resources (Giraldeau&Caraco 2000). In the animal behaviour literature this is called scrounging (Barnard &Sibly 1981) or using public information (Valone 1996). Animals that look for resources are called "Producers" and those who exploit resources found by others are called "Scroungers". There are a number of mathematical models (ex. Vickery *et al.* 1991) which predict when animals should scrounge and what proportion of a group should scrounge. Notably, if all group members decide to scrounge all the time, no resources will be found and all group members will obtain nothing. On the other hand, if only one group member scrounges it may profit from all the resources found by others while losing very little by not searching itself. Thus, there will often be a temptation to scrounge provided not too many others are scrounging.

There is considerable evidence that animals do scrounge from one another. The idea originated with Barnard &Sibly's (1981) observation of house sparrows feeding in flocks. Subsequently, zebra finches (Beauchamp 2001), nutmeg manikins (Coolen, Giraldeau& Lavoie 2001), crows (Bugnar&Kotrshal 2002; Ha & Ha 2003), and grackles (Morand-Ferron, Giraldeau& Lefebvre (2007), all flock feeders, have been shown to scrounge. Recently, primates have been shown to scrounge (Di

Bitetti&Janson 2001; Bicca-Marques & Garber 2005). There is even evidence that a non-social mammal (the red squirrels) will scrounge (Leroy 2010).

In the examples above, animals profit by learning the location of food from others. While the profit is food, the process involves learning. As learning is involved, animals can scrounge more than just resources; they can also learn from conspecifics. For instance, Giraldeau & Lefebvre (1987) showed that, under some circumstances, a pigeon can learn a complex task by watching another pigeon perform the task. We know that humans also learn by observing one another in a process sometimes called "social learning" (Kameda & Nakanishi, 2002, Mesoudi 2008; Eriksson &Stirmling 2009). The latter two suggest that humans may learn best through a mix of individual and social learning. This is an interesting conclusion in the context of PBL which asks students to alternate between individual and social learning.

I expect that models explaining animal behaviour are also relevant to human behaviour both because humans are animals and because humans live in societies where food and knowledge are shared. There is a difference, however, between sharing food and sharing knowledge in that food can be consumed only once while knowledge can be shared without decreasing its value to the animal which discovered it. I expect this difference may make information scrounging more prevalent than food scrounging and its consequences more extreme. Human intelligence may make us particularly adept at acquiring information from others.

SCROUNGING IN PBL

In the PBL context, if we consider knowledge as a resource that can be acquired by one individual and then shared by others, then problem-based learning is easily open to scrounging. We define producers as students who prepare themselves prior to group meetings and bring knowledge, ideas and understanding to the group. Those who don't prepare will bring nothing to the group which they could not have contributed prior to encountering the problem. They will simply try to scrounge new knowledge from those who have prepared for the group discussion. Still others may prepare only superficially and thus make a limited contribution to the group. These students will also try to scrounge knowledge from their better-prepared colleagues. This behaviour has been referred to as social loafing (Ingham*et al*. 1974) and its practitioners as free-riders. Here I will define scrounging as learning from the knowledge, ideas and understanding provided by other group members.

We can learn about the prevalence of scrounging that we should expect within PBL groups from studies of animal behaviour. The most relevant point in these studies is that scrounging occurs when resources can be shared and when the animal which finds

the resource is unable or unwilling to prevent others from exploiting its find. These conditions clearly apply to PBL because we encourage students to share their knowledge. Further those who discover the knowledge lose nothing in sharing it with others (unlike resources such as food which cannot be consumed by more than one individual). We should therefore expect scrounging to be common in PBL groups.

My personal observation in fifteen years' experience with PBL is that some students are often less than adequately prepared for tutorials. In our form of PBL we give a group of students a problem to analyse. Because the problem always surpasses their current understanding in their field of study they must analyse it, propose hypotheses to explain the problem and then seek a better understanding of the problem by reading in the subject area. Each student is responsible for reading all the material necessary to understand the problem. Once the reading has been completed the students meet again to discuss what they have learned, to compare their various understandings of the problem, to confirm and to consolidate what they have learned. In general, students come to this second tutorial with various degrees of preparedness. Occasionally a few students appear not to have prepared at all. These students tend to have little to add to discussions. When they do speak they either paraphrase what others have said or repeat ideas which were put forward when the problem was first introduced. Despite their lack of preparation, these students do learn. Evidence for this is the fact that they can paraphrase what others have said. In some cases a student may draw interesting conclusions from what others have said without having adequately prepared himself. This actually contributes understanding to the group. However, failure to prepare usually penalises all group members.

A student who does not prepare adequately before a tutorial will be less able to understand and integrate the ideas presented by peers during the tutorial and also less able to evaluate and criticize statements made by others. This leaves the student open to information cascades (Bikhchandi *et al.* 1998) in which false information presented by one group member happens to be accepted by the whole group as a result of a few uncritical acceptances by some early participants in the discussion. Rieucau & Girladeau (2011) showed than birds can be induced to make poor choices of where to feed if they are shown a video of other birds feeding at a poor quality location. Finally, the unprepared student will be less likely to develop a coherent understanding of the various concepts being studied in a given problem. The student who doesn't prepare hopes to gain an adequate understanding of the subject despite these impediments.

When one or more students within a group fail to prepare adequately the other group members will also suffer. Even if the remaining students are well-prepared the group is more likely to miss certain essential details of a problem. Indeed, the success of tutorial discussions often depends on students presenting different points of view or drawing

conclusions from different sets of information (see Dolman and Schmidt 2006 on cognitive conflicts leading to conceptual change or Savin-Baden 2000 on active participation in legitimate group debates). If some students don't bring the necessary information or level of reflection to the tutorial then discussions may reflect only the idea of a few students with little chance for in-depth analysis. I have seen a few tutorial groups in which one or two students have done the majority of the work with the rest of the group relying on them because they were known to be the brightest students in the class. In the extreme case this gives the role of teacher to the brightest students leaving the others as passive learners. Results from these groups suggest that the passive learners don't learn as well as I would expect, perhaps no better than if they had been presented the same material in a lecture format. Van den Hurk *et al*. (1999) have shown that student-generated learning issues can enrich discussions and improve learning within the study group.

The hard-working students also suffered. Lack of support and of discussion from other group members meant they had to work harder to develop the level of understanding they felt they needed. They were often forced to engage the tutor on certain points because their classmates were unprepared for discussions at an advanced level. The lack of effort by the scrounging students appeared to hurt overall team performance by reducing interpersonal exchanges as suggested by Van den Bossche *et al.* (2006).

It is clear that PBL places students in a position where scrounging knowledge from colleagues can be an attractive option. When students rely only on scrounging they will tend to learn less and they will reduce learning opportunities for others. This reduced performance by the group has a parallel in the animal world; groups in which scrounging is prevalent will likely find less food and fare less well than those which scrounge less (Vickery *et al.* 1991, Coolen, Giraldeau & Vickery 2007). There is some controversy as to whether human groups suffer a similar reduction in learning as Rogers (1988) claims that social learning will evolve to perform no better than individual learning while Kameda & Nakanshi (2003) propose that alternating between individual and social learning will benefit the whole group.

SHOULD WE TRY TO ELIMINATE SCROUNGING?

Based on this discussion it might appear that scrounging can be a serious problem in PBL, but scrounging, in the form of social learning, is an essential component of PBL. Sharing and comparing information, ideas and analyses is fundamental to PBL. We want students to scrounge from one another in the sense that each student will come to the tutorial with slightly different information and possibly quite different interpretations of their information. The discussion, validation and analyses of various students' points of view is in fact a form of scrounging that is essential if PBL is to

foster learning and the use of knowledge. Each student will supplement personal knowledge with what others have found. Students may adopt ideas proposed by others and readjust their conceptual map in a given field based on what colleagues say. All this is a form of scrounging in that it involves taking resources (adopting ideas) which have been found by others. It is all essential to PBL.

Thus we do not want to eliminate scrounging from PBL; rather we would like to ensure adequate levels of producing in order to maximise the combined benefit of individual and social learning. Specifically, we want students to invest sufficiently in individual learning so that their group discussions will promote clear understanding of the concepts being studied.

CONTROLLING LEVELS OF PRODUCING AND SCROUNGING IN SOCIAL LEARNING

Producer-scrounger theory can help us understand when students are likely to invest in producing and when they are more likely to rely only on scrounging. We know that scrounging will increase as resources become easier to share (Giraldeau, Hogan & Clinchy 1990). A list of facts is easily shared. Thus, if the learning objective of a PBL tutorial is to compile and learn a series of facts we can expect many students to rely on others to bring the facts to the tutorial and to share them (many students will not produce). If, on the other hand, we want students to understand concepts related to a series of facts it will be difficult to understand the concepts without the facts so most students will likely at least prepare their facts. If we ask students to use the concepts in order to build something (abstractly or concretely) they will need to prepare both facts and concepts (and probably develop some idea of how they will use them as building blocks). Thus, the level of understanding that we require of our students will influence the amount of effort they invest in individual learning.

We can analyse the situation in terms of the producer-scrounger game by considering the finder's advantage, the gain made by the producer which is unavailable to subsequent scroungers (Vickery *et al.* 1991). When only facts are being accumulated all group members will obtain all the facts during the tutorial. There will be no finder's advantage so we can expect most students not to produce (not invest in much personal learning). Producers (=finders) appear to be losers in this context because they do the work but gain no more than their scrounging colleagues. When prior personal learning is necessary to understand complex concepts and processes the finder (the student who invests in personal learning) has the advantage of better understanding and evaluating subsequent group discussions. This situation should encourage producing (investment in personal learning) because the finder's advantage can be quite large.

This situation takes us back to the reasons why teachers adopt PBL. PBL is appropriate to learning complex concepts which will be put to some use (either abstract or concrete). PBL will likely be inefficient if the objective is simply to accumulate information. It is unclear when the accumulation of information without context or use might be a legitimate learning objective. I raise the point here because some university courses seem to assume that knowledge should be accumulated and that a student's performance in a course should be measured solely by the amount of knowledge acquired (see Mayer 1999 for a discussion of information transfer versus construction). This approach is not well-served by PBL. I would argue that this approach is not appropriate to higher learning which should instead favour understanding and use of acquired knowledge, an ability to synthesise this new knowledge with old and an ability to criticise ideas based on the understanding acquired. These are objectives which can, and should, be developed in PBL (Kolmos and de Graaff 2003, Savery 2006) .

There are a number of strategies which can be adopted to favour social learning without suffering from excessive scrounging. Importantly, students should understand what is expected of them. They should realise that they will be expected to understand and use the ideas which they acquire during the course. If they will be required to produce something (an object, an argument, a treatise …) they should have a clear set of goals (Forsyth 2010) in advance so that they can adjust their personal study as a consequence. However, requirements should not be too rigid because allowing students to make choices increases their motivation to learn (Kolmos and de Graaff, 2003).

The evaluation of the student's performance should also reflect the learning objectives. There is no point in telling students that they must develop a deep understanding of the concepts in their field if course evaluations are based on exams which test the ability to remember facts. Students will adjust to learning objectives based on the evidence they receive about what is important in their evaluation. Biggs and Tang (2011) argue for the "constructive alignment" of objectives, learning opportunities and evaluation in order to obtain quality learning.

Group dynamics can also influence the way in which students prepare for tutorials. Making students responsible to each other (creating mutual dependency Fjuk and Dirckinck-Holmfeld 1997) within tutorial groups can generate social pressure which will motivate some students to prepare more than the strict minimum. If students don't prepare sufficiently for tutorials, tutors can speak to them privately or they can point out that poor preparation hurts not only the poorly-prepared individual but also the entire group.

Formal evaluation of a student's contribution to the tutorial group can discourage social loafing (Forsyth 2010). Most PBL programmes aim to create autonomous learners. In

these cases it is appropriate to evaluate the extent to which a student has learned personally prior to a tutorial. Students should understand that they expected to acquire not only understanding of the material but also the ability to find and synthesize knowledge on their own. Another common aim is to encourage students to work well in teams. In such cases it is appropriate to evaluate the student's contribution to the team effort. Such evaluations send a message to the student that personal preparation for a tutorial is important. Evaluations can be made by tutors, if they are involved in the tutorial, or by students. (See Papinczak *et al.* 2007 for a detailed analysis of the effects of peer evaluation in problem-based learning). My experience in a programme which uses both approaches is that students are often more severe than tutors in their evaluation of colleagues who do not pull their weight. These evaluations require some care in order to evaluate exactly the aims of the programme and encourage students to attain them. For instance it is important to evaluate the depth of understanding presented by a student more than the quantity of information brought forward.

It is important to note that certain benefits of PBL, such as the ability to research a topic and identify relevant material cannot be scrounged. Failing to produce (to accomplish the research phase of the PBL) in preparation for a tutorial will prevent a student from acquiring this essential skill. Students who have the goal of learning how to learn should thus be less tempted to scrounge from others what they should be preparing for their group.

In the context of producer-scrounger games, evaluating contribution to a group produces an additional finder's advantage. The student who brings interesting material to a tutorial not only gains a better understanding of the material (as discussed earlier) but receives a bonus based on a positive evaluation of the student's contribution to the group.

Evaluation of group performance can also encourage students to contribute more to their group (Forsyth 2010), to take responsibility for their work within the group and thus promote group cohesion. (See Van den Bossche*et al.*2006 for a discussion of the benefits of group cohesion). I suggest that such evaluations should be based on a scale which measures how well the group has attained the objectives of the exercise rather than a comparison of results among different groups. The latter approach may prevent groups from sharing resources which would be counterproductive to learning. In addition, it promotes an ethic of working more than others rather than working to attain a goal.

IMPOSING A COST OF SCROUNGING

Another possible way of encouraging producing is by imposing a cost to students for access to their colleagues' knowledge. For instance, students might be required to prove that they have prepared for the tutorial before joining in discussions. Students who could not prove that they had prepared sufficiently could be excluded for all (or part of) the tutorial session forcing them to rely only on their own personal work. This could act as a double-edged sword for both the student and the educator. The student who doesn't prepare for a tutorial will be obliged to rely only on personal learning. Since this was inadequate the student will have to work harder on individual studies to compensate for the lost access to group study. This additional personal work should be enough to regain eligibility to re-join the tutorial group.

The opposite result is also possible. Mesoudi (2008) showed that when a cost is imposed on access to social information, people tend to rely more on personal information. In this case, imposing a cost on access to tutorials could encourage some students to abandon the tutorials in favour of working on their own. It would be particularly disappointing if some of the harder-working students were to drop out of tutorials. Mesoudi's work may not, however, apply to PBL because his subjects acquired personal information at no cost compared to costly social information. In PBL, personal information comes at a high cost of effort invested compared to the acquisition of social information. Students may then compare the cost of personal vs social information when deciding how to study. Any attempt to impose costs on access to tutorials should take this into account.

THE EFFECTS OF GROUP SIZE

One might be tempted to increase the size of a study group in order to compensate for the lack of preparation by some students; suggesting that if each student works less, then having more students present will compensate for the lack of effort. (Miflin 2004 provides a recent analysis of the importance of group size in PBL). Producer-scrounger theory (Vickery *et al.* 1991; Coolen, Giraldeau & Lavoie 2001) shows that this approach is not likely to work because as group size increases the expected equilibrium proportion of producers decreases. Interestingly, Vickery *et* al. (1991) predict a nonlinear decrease in production which fits well with Ingham*et al.* (1974) observation that social loafing increases nonlinearly with group size. This increase in loafing (decrease in individual study effort) can occur because a student will feel the personal share of the load is smaller as the group gets larger thus justifying less effort in personal preparation (Forsyth 2010). Larger groups may also discourage producers in other ways. Each student has less time to participate as the tutorial group gets bigger. Students in a

large group may find they don't get enough time to express their ideas or that their idea has already been described by someone else. They may then use less effort to prepare for future tutorials. This phenomenon underlies the importance, regardless of group size, of requiring each student to contribute to the tutorial. When students present redundant material they often use slightly different language to express themselves. This can be used by a tutor to generate a discussion of the point in order to attain better understanding. Generating this discussion will have the side effect of confirming the value of the point made by both students (despite the redundancy). This will encourage students to keep seeking new ideas and to express them in discussions. Tutors can encourage students to give their own point of view on a subject covered by someone else in order to foster both deeper understanding and personal responsibility for thorough preparedness. For autonomous tutorials (without tutors) students will need to be trained to seek deeper understanding by exploring alternate points of view even when differences are slight.

MOTIVATION

Motivation drives students to learn. If students enrol for higher education we assume they do so because they want to learn. Why then don't they invest all their time in studying? I think the answer is at least two-fold. First, students have other things to do in their lives including eating, sleeping, and travelling to and from school. A normal student will also invest in social activity, exercise, and possibly employment or community service. All of these require time. This time will not be available for the study of problems set by a PBL tutor. We need to consider producing and scrounging in the light of these other activities and the relative importance that the student gives to learning in a daily time-budget. Some of the above activities are more important than learning. Certainly failure to eat or sleep will have a negative effect on a student's health (as well as on the ability to learn). So we can't expect learning to be the sole consuming passion of a student's life. Rather, we want to encourage the student to value learning highly enough to allocate sufficient time to studies even at the expense of such things as social activities, employment etc.

This brings us to the other part of our answer to the question of why students don't spend all their time studying. Sometimes studying is boring. The issue for PBL is to produce problems which will induce students to invest their time in searching for solutions (or at least better understanding). I have heard colleagues say that the problems in PBL are just scenarios which require students to study. They should be much more than that. Problems should challenge and engage students, generating a desire to know and to learn (see Mauffette, Kandlbinder & Soucisse 2004, Kolmos and de Graaff 2003). When students are motivated in this way they will increase the priority for learning in their daily time budget and seek better understanding of the problem.

When problems are boring, students are more likely to trade-off their study time to some more interesting activity and become PBL scroungers rather than PBL producers. (Van den Hurk *et al*. 1999 provide an analysis of the effects of student involvement in tutorials, study effort and learning).

Thus PBL practitioners have two ways to discourage scrounging: make the problems so interesting that students will prioritise their studies and make it clear that students will be evaluated on their preparedness for tutorials.

ALL STUDENTS ARE DIFFERENT AND CAN BE EXPECTED TO REACT DIFFERENTLY

My discussion so far has treated all students as equal. But every student is different (see Dillenbourg 1999 for a more thorough discussion of this point). Students differ in their abilities to read, to assimilate, to remember, to integrate and to explain that which they have read. These differences may lead some students to produce more than others. When birds forage in flocks those that are less able to find food for themselves are more likely to scrounge food from others than those who find food easily (Giraldeau & Lefebvre 1986, Hamilton 2002; Beauchamp 2006). We can expect a similar situation in tutorial groups where the quickest learners will likely come to tutorials prepared and slower students will be less well prepared. The latter will rely on the expertise of the top students in order to learn "socially" during the tutorial.

This is a pattern which I see often in tutorial groups: the top students take the lead in discussions and the weaker students follow them. This is particularly dangerous for the weaker students because they may lack the prior knowledge to keep up with the rest of the class. (Dillenbourg 1999 also addresses this situation). Tutors should be vigilant to avoid this situation. They can insist that all members of the group understand a given concept before moving on to new material. The ill-prepared student who is unable to keep up may be forced to do some additional reading following the tutorial. This sends a message to the student that it would be better to prepare before the tutorial than to be embarrassed in front of peers and forced to do the work later.

Another approach which can encourage weaker students to prepare properly for their tutorials, rather than merely scrounging, is to encourage them to improve on their weak points and to point out any innovative ideas they bring to the tutorial. The positive feedback should encourage them to try to repeat their success. In addition, if contributions to the tutorial are being evaluated, the evaluator should account for the student's capacity for personal learning when judging the student's success. To be harsh with a slow student who is working hard but having trouble keeping up with the others

can be very discouraging. Unjust appraisal of a student's work can undermine motivation and lead to a lack of future effort.

Individual differences among students can lead them to propose a division of labour where some students take on the responsibility of bringing new information and ideas to the group while accepting that others look after administrative details such as structuring communication within the group, communicating with the tutor and submitting final products. This appears to be an efficient use of manpower from the point of view of students who have a task to accomplish, but it isn't an efficient way to learn. Students will tend to refine their strengths while remaining weak in other aspects of team work. Further, learning will depend mostly on a few stronger students; weaker students may get credit for accomplishing other tasks but will be at risk of not learning the concepts under study. Tutors can ban such divisions of labour or they can attribute the non-academic roles randomly to group members for each problem and then insist that everyone is equally responsible for the academic aspects of the problem.

CONCLUSION

The sharing of ideas, which can be looked at as a form of scrounging, is essential to forms of PBL which use social learning. However, social learning is susceptible to levels of scrounging that can degrade the learning experience when students rely excessively on the work of others in order to learn rather than producing for themselves. A student who fails to prepare adequately contributes little to a group with the result that both the student and other group members will probably learn less. Educators can limit the negative effects of this scrounging in a number of ways. If problems are stimulating and require analysis (not just the accumulation of facts) students are more likely to make an important contribution to team tutorials. Social pressure and evaluation of individual effort and group results can also encourage students to produce for their group rather than only scrounging what others have learned. In all cases tutors should be attentive to each student's abilities and contributions in order to encourage realisation of the student's full potential in the PBL environment.

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[1] This text uses masculine pronouns to refer to people in order to make it easier to read. It should be understood in all cases that the people involved may be either men or women.

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Transversal knowledge formations in Professional Bachelor Education employing Problem Based Learning (PBL)

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ABSTRACT

This paper describes the principles underlying how various knowledge areas blend into transversal formations in two educational contexts employing PBL. Such 'transversality' has often been referred to as inter- cross- or trans-disciplinarity. However, these terms are ambiguous, especially in relation to Problem Based Learning. There is a growing need for stronger language to express underlying principles of knowledge formations and the constitution of such. The term transversality suggests that knowledge formations are not based on a relationship between strong independent disciplines, but rather on a number of subject areas that are combined during students' PBL-studies. As such, the curriculum organized knowledge, as well as students' reflections of various types at the level of teaching and learning, constitute certain 'modalities' of transversal knowledge formations. Two institutional case studies - Nursing and the Constructing Architect education - have been researched, compared and contrasted in order to demonstrate how institutional practices demonstrate different modalities of transversal knowledge in their PBL-courses. For the purpose of this paper Nursing Education will be abbreviated as NE and Constructing Architect as CAE.

RESEARCH BACKGROUND AND EMPIRICAL CONTEXT

The empirical field for my research is a separate sector of higher education in Denmark called "Professional Bachelor Education", with degree programs lasting 3½ year duration each with their own judicial framework within higher education as well as their own structure within institutions deemed 'University Colleges'. Examples of such programs include: Teacher, Nurse, Social Work, Social Education, Constructing Architect, and Diploma Engineer. In

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general, these courses of study are neither entirely academic nor vocational, but a combination of both. The concept 'Professional Bachelor Education', which covers technical fields such as Diploma Engineers and Constructing Architects, grew out of the increasing demand for 'technicians' in the rapidly developing industrial society of the 1950s and 60s. In the early 2000s they became known as 'Professional Bachelor Education' as a result of the Bologna process which also raised demands relating to academic skills. However many Professional Bachelor Educations still retain strong links to vocational fields, resulting in growing tension between academic and practical-based orientation during recent years. What is considered as 'knowledge' has never been more political and power related. This article highlights the constraints, opportunities and challenges that develop when organizing knowledge in such educational contexts. The actual empirical studies are conducted in two separate institutional contexts in Denmark, Nursing education and Constructing Architect which also represent two very different cultures, but within the same educational sector. Both institutions have agreed to the use of gathered data for Ph.D.-research and publishing on the condition that the institutions and all persons related to them remain anonymous.

TRANSVERSAL KNOWLEDGE – IS IT JUST ANOTHER NEW WORD?

Why use the term 'transversality' instead of multi-, inter- or trans-disciplinary? Existing terms suggest various forms of inter-relationships among disciplines (Klein 2010). However, I argue that these terms make no sense if disciplines are not also included in a curriculum. My analysis shows that in each of the two institutional cases 'disciplines' no longer exist as fields of knowledge distinct from each other.

Over recent years 'disciplinarity', understood to be the preservation of the traditional independence of subject disciplines… has been a hot issue in the Danish educational debate, with increasing criticism of "soft" pedagogies, for example, project work and problem/case based study work. It has been argued that such pedagogies do not facilitate learners in acquiring disciplinary understanding. The closest related term to 'disciplinarity' in Danish is 'faglighed,' a term which has different meanings arising from at least two different semantic fields (Krogh 2005). It can refer to the skills, norms, and attitudes one needs to possess in order to perform in a certain profession, but it can also refer to educational disciplines/subjects and the acquiring of such within the educational system (Fink 2003) (Jensen 2007). It is often unclear whether reference is made to one or the other field, which is why it can be argued that these 'disciplinarity-terms' poorly characterize educational knowledge formations in PBL-pedagogies. My argument is inspired by the work of S. Stavrou who related the term 'transversality' to changing processes in higher education (Stavrou 2011). I use the same term to refer to similar change processes, which I will describe in further detail in this article.

THEORY AND METHODOLOGY

I have taken a sociological and discursive perspective to carry out curriculum analysis with my main inspiration coming from B. Bernstein and N. Fairclough. I combine their two approaches in order to examine the current understanding of knowledge and the transformation of such knowledge at different levels in the educational system. Combining Fairclough's and Bernstein's methods allows us to examine discursive formations properly in the field of professional bachelor education (Fairclough 2002).

Fairclough offers socio-linguistic tools to draw up discourses of "what counts as knowledge and learning," while Bernstein's theoretical framework provides the means of analyzing transformative processes of knowledge from outside academia into curricular and pedagogical practice. Bernstein's work has often been used to analyse power relations in organizing and structuring knowledge in curriculum. In my work I also apply recent developments within the Bernsteinian tradition by applying the Legitimation code theory (LCT) of Karl Maton. Fig. 1 shows an analytical model for dividing up transmission fields (Maton 2012 – forthcoming)[i].

A key concept in transformation processes of knowledge is Bernstein's term of 'recontextualization', which emphasizes that a discipline within education is different from its origin outside academia (Bernstein 2001).

On its way from its primary production field into academia knowledge is 'pedagogized' so it becomes suited to learning. This is done through various recontextualization processes at various levels (Maton 2013, forthcoming) where all 'educationalist' involved… planners lecturers etc., select and organize knowledge for the curriculum and for reproduction in pedagogical interaction. Together with this term of recontextualization Maton's specialization codes for 'epistemic relation' ER and 'social relation' SR within knowledge fields are used to examine historical changes in the way knowledge is transformed from outside to within academia (Bernstein 2000s. 28-39). These concepts and codes – which will be further developed later - demonstrate how disciplinary content and boundaries between disciplines have gradually 'blurred' over a period of decades, and that power and control over the disciplinary content have been decentralized to lower recontextualization levels (Fig. 3)., which eventually gave rise to new pedagogical approaches such as PBL.

The analytical approach therefore also gives an understanding of the contemporary organization of knowledge within the curriculum, as a more or less fragmented formation of disciplines/subjects. Such 'knowledge organization' can be seen as creating a new 'federation'… a term inspired by J. Muller, who related the concept to the term, 'region', previously developed by Bernstein (Muller 2011b)(Muller 2011b) . A 'region' or 'regionalization' meant that individual disciplines are recontextualized into larger units for the

purpose of moving closer to the external interests of the practice field involved. In other words increased market orientation (Bernstein 2000s. 52) (Barnett 1994).

This tendency of 'regionalization' has influenced education on a large scale and results from changing political orientations at macro level. Modulising and professionalizing educational programs in higher education is an example of regionalization (Stavrou 2009). Here I use the term 'federation' for smaller units where disciplines/subjects are brought together in for example PBL-cases or projects within an educational program. The point is that such 'federations', require some kind of inter-disciplinary – or transversal - interaction.

My findings in the two cases show, that PBL has become an important factor in establishing a pedagogical framework around the 'federations' of weakened disciplines/subjects for creating transversal knowledge formations. New spaces for the student's to link and build arguments between the various subjects and theories within the federation of subjects arise. One of my main points considers the basis for PBL in the two educational contexts, and thereby the current conditions for transversal knowledge formations, is established through the historical developments in curriculum. Therefore I also argue that transversal knowledge formations need to be understood as a result of both formal and enacted curriculum. In the Bernsteinan tradition this involves two different types of 'fields' shown in the figure below: The 'field of recontextualisation' and field of 'reproduction' (Bernstein 2000s. 36)(Maton, 2013, forthcoming) Transversal knowledge formations are 'products' of both planners/lecturers who recontextualize the knowledge from the fields of production and processes of reproduction, i.e. teaching and learning. Understanding transversal knowledge in PBL means understanding the transformation processes in the two fields.

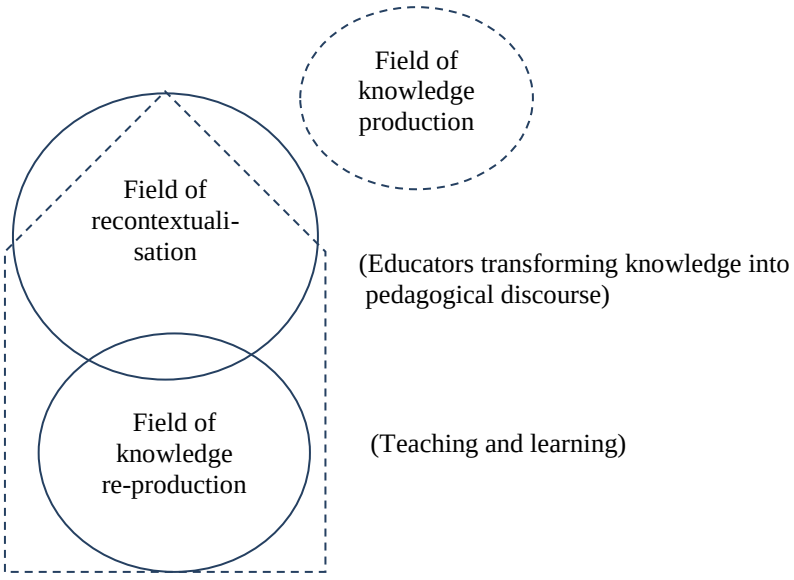


Fig. 1: Fields involved in transversal knowledge formation, inspired by K. Maton[ii]

THE 'RIGHT KIND OF' KNOWLEDGE… WHAT IS IT? – DISCOURSES ABOUT KNOWLEDGE AND LEARNING

The first step in researching knowledge transformation was analyzing curriculum design processes for the two institutional case studies, Nursing and Constructing Architect educations, where focus was on discourses about knowledge and learning in order to identify the forces driving the changes towards the formation of federations. Various levels of documentation; directives, circulars, syllabuses etc., as well as statements from educational planners and lecturers, have been examined in order to identify dominant discourses of "knowledge and learning". Here I have drawn on N. Fairclough's theories and analytical tools (Fairclough 2002). His key concept, 'interdiscursivity,' expresses 'discursive formations' of struggling knowledge discourses where alliances and hegemony can be identified (Foucault 1986 s. 115-117) (Winther Jørgensen, Phillips 2000).

A struggle emerges in the case of nursing education (NE), between two different sets of values concerning knowledge and learning… an academic discourse and a 'practice' discourse. Educators at the NE- institution attempt to include both. As one lecturer states:

> "Fifty years ago you could say we were the doctor's 'right and 'left' hand. We did what the doctor told us to and that was it. On ward rounds we were the 'back row' holding the soap dish and the towel for the doctor – it was a virtue. This is not what we teach the students today. So from being an assisting discipline – doing what we were told to do – today we are more an independent profession with our own professional field – our own area- and even developing our own theories on their own basis. This gives us something to argue with and act on" (lecturer LK)"

In the other case, CAE, there is more skepticism about theorization and academic thinking. A younger lecturer reflects:

> "I think there is a limit.. and this limit is defined by the fact that we are a professional bachelor education. The industry expects that the students we 'let out' - in one way or another - are capable of carrying out the work from day one. If you instead come from a traditional university then everyone knows that at least the first year and a half will pass before one has found out what exactly to do. You don't know "anything at all", (edit.) about what to use your knowledge for. So I think there is a risk by pushing them too much to the academic world" (lecturer DE 654)

As these quotes indicate, the nursing education has tried to find a balance between orientation towards the academic world and the field of practice, whereas the constructing architect education relates mostly to the practice or 'craft' discourse with less emphasis on developing the profession through academic virtues.

TRANSFORMATIONS OF CURRICULUM DISCIPLINES

The next step involved conducting research on changes in the curriculum disciplines especially with regards to the introduction of new reforms. K. Maton's concepts of 'epistemic relation' (ER) and 'social relation' (SR) have been powerful in this analysis. The concepts are a further development of Bernstein's codes of classification and framing and they express structuring principles of knowledge. The main argument here is that every knowledge practice has a 'knowledge structure' and a 'knower structure' but with different strengths expressed by the strength of 'epistemic relation' and 'social relation', ER+/-, SR+/-. Thus a strong 'knowledge code' is annotated, ER+/SR- and a strong 'knower code', ER-/SR+ (Maton 2008). For a knowledge area such as a curriculum discipline 'Epistemic relation', ER, represents the statements, propositions, procedures and techniques that are distinct from the individual knower. 'Social relation, (SR) represents the subjective dispositions specific for each individual knower such as class, gender, personal style, experience, preferences etc. (Maton 2008).

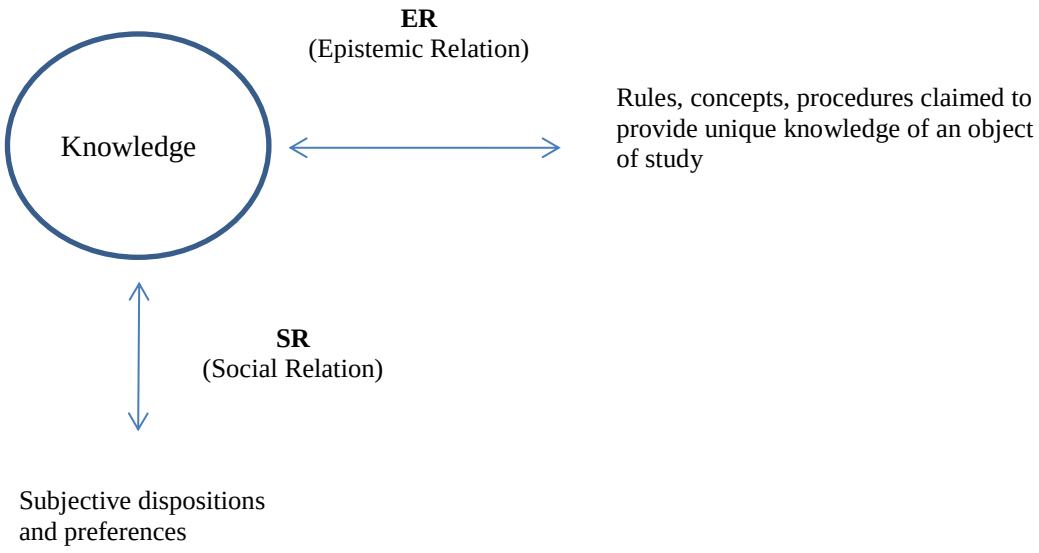


Fig. 2: Epistemic relation and social relation of knowledge (Maton 2000a) – My modification

These concepts can help to understand those changes within curriculums where there has been a shift in the code for the individual disciplines in curriculum from relatively strong to relatively weaker 'epistemic relations' (ER+↓-). At the same time there has been a shift from relatively weak 'social relation' to relatively stronger 'social relation' (SR-↑+).

The research process leading to this statement is based on interviews and document research including directives, syllabuses, study programs etc. over several decades. Changes in 'epistemic relation' (ER) have been examined on the basis of the degree to which content (theories, methods etc.) and assessment criteria within each discipline were made explicit in the documents. Changes in 'social relation' (SR) have been examined on the basis of the degree to which student's preferences, judgments and experiences are allowed for or expected.

This research shows that the content and assessment criterion within each discipline has become less explicit over time. This is particularly evident in CAE. However, these changes must be considered along with the 'displacements' of recontextualization. Some decisions about disciplines previously made at the top level in the educational system (State/Ministry) have gradually been pushed down to the institutional levels (see fig 3). Such displacements are due to modernization processes in the public sector through the 80s and 90s in general. It is what some sociologists have called a double 'counter-movement': Decentralization and centralization (Sørensen 2001).

An important point here is that descriptions of disciplines do not disappear, but are moved to lower recontextualization fields, where planners and lecturers are responsible for specifying content. In CAE the disciplines are only explicitly described in the student's time-table. As a result they still operate in the classrooms, but no longer have their legitimate basis from legislation in terms of the resources previously defined in directives in terms such as teaching units and external exams etc. The 'materiality' of 'single disciplinarity-discourse' has eroded (Neumann 2001).

Fig. 3 illustrates the main changes. Arrows indicate how decisions about the organization of knowledge are pushed down through the recontextualization fields. The contemporary syllabuses describe the learning objectives and knowledge content in general terms. Disciplinary content is today more often termed as 'subjects' or 'themes'. The changes are most significant in CAE.

In NE there remains a division of disciplines, but the boundaries between them are unclear. It is worth noting that NE includes disciplines from both human and science cultures, so there is a difference. Humanity disciplines such as 'Nursing', 'Ethics, Philosophy and Religion' etc.' are less demarcated than the science disciplines: 'Anatomy and physiology' and 'Pharmacology', the latter still being an independent course unit. This corresponds to the insight about knowledge structures developed by Bernstein and expanded upon more recently by K. Maton and J. Muller (Bernstein 2001) (Muller 2011a) (Maton 2011a). They argue that scientific cultures have hierarchical knowledge structures and humanist cultures have horizontal knowledge structures (Maton 2008s. 92).

These curriculum changes have generated higher complexity in the educational system up to a point, where it had to be dealt with… one way or another (Gleerup 1997). Attempting to reinforce 'epistemic relations' in the disciplines, could well be an attempt to return to the past, but this is probably not possible. Other countermoves need to be made. The question then becomes: How can a weak 'knowledge code' for each discipline be met? Problem Based Learning (PBL) seems to have emerged as one of the answers, not "redeeming" each discipline, but by legitimizing the strong 'knower code' (ER-/SR+) , as PBL-pedagogical aims to emphasize student involvement and more active engagement in what and how to learn. In the CAE-case PBL was introduced in the late 1990s and in the NE-case about 2008.

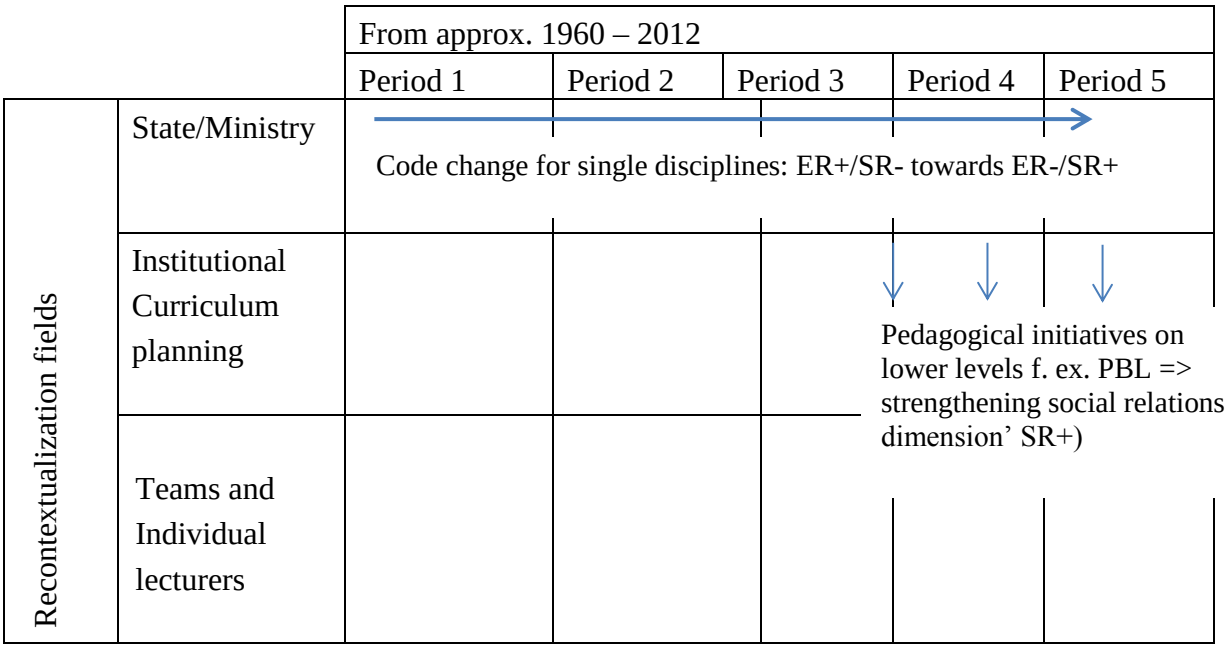


Fig. 3: Diagram for analyzing curriculum changes in the two cases
Notes: The period division marks new reforms. Vertically the various levels in recontextualization are shown

To stress the overall point: Over the years there has been a change in curriculum from a collection of separate and relatively clearly defined disciplines, towards an integration of subjects (Bernstein 1971) where each discipline tends to loose explicit specifications of objects and content. The weakening of the 'knowledge code' (ER+/SR-) for each discipline should be "compensated" for and it seems this has been done by strengthening the 'knower code' (ER-/SR+) through greater student involvement boosted by PBL-pedagogy, where it is up to the students to combine the more fragmented knowledge pieces together in this more open pedagogical approach. Students are encouraged to actively try to establish links between the disciplines with greater emphasis on subjective dispositions (SR+). PBL in professional education in DK has proved to be a strong concept of learning, but it has also been challenged by criticism of being unclear about the "disciplinary quality". My analysis show that such

quality can no longer be found in each of the disciplines, but must be found in the way that students transverse them when they actively engage in PBL-work.

PBL AS PART OF A REGIONALIZATION PROCESS - GATHERING THE REMAINS OF THE SUBJECTS IN 'FEDERATIONS'

In NE and CAE, PBL is used in two very different ways and each institution has their own motives for implementing this pedagogical concept. However, for both institutions PBL functions as a response to the changes outlined in the previous section. PBL is a new 'frame' that is being used to tackle the 'didactical uncertainties' following the curriculum changes. PBL tackles this difficult task with very different results in each of the two cases. The following illustration simplifies the main movements in the curriculum history as a regionalization towards 'federal' constellations. It is important to note that the three movements (in fig 4.) must not be understood as causal relationships, rather as main processes in a complex curriculum history.

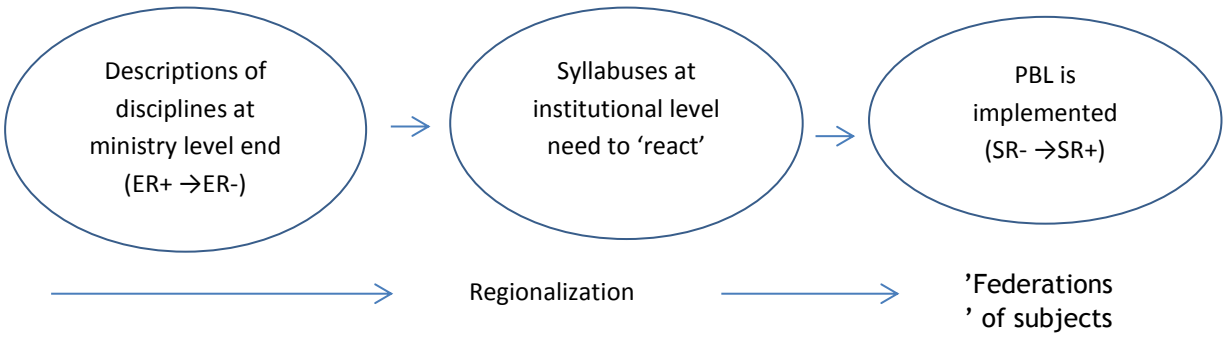


Fig. 4: Curriculum change processes

I will not go further into all of the principles of PBL here, only emphasize that 'problem-orientation' assigns another function to the curriculum disciplines. The students need to learn from the disciplines what is relevant to solve or interpret the problem in the PBL-program. They need to apply knowledge. The student's considerations of applicability and relevance of the disciplines within the 'federation' are therefore equally, if not more, important. The two institutional cases are exceptional examples of how knowledge organization is no longer represented by single disciplines with explicit specifications of content and assessment criteria. In that sense 'disciplinarity' "has gone". The PBL-programs are new federations of subjects. As the term inter-disciplinarity depends on single disciplinarity, it does not make sense to use it in this context. Transversality is a more accurate term, which has previously been used in higher education research to describe similar processes (Stavrou 2011, Stavrou 2009). As Bernstein argues, regionalization can be both orientated to the intellectual fields

and the practice fields. If the selection of content, study methods etc. is driven by the academic way of thinking it can be termed 'introjection' (Bernstein 1996)(Sarakinioti, Tsatsaroni & Stamelos 2011). If instead the orientation is related to the values of the fields of practice (market) it is termed 'projection'. The two cases exhibit quite different orientations, as will be discussed further in the following sections.

PBL IN CONSTRUCTING ARCHITECT EDUCATION (CAE): "A TIGHT FEDERATION"

PBL as project work

Here the PBL idea is linked to project-work. Each project runs for a semester (½ year) and is carried out in groups of 3-4 students. The projects relate to technical building design and have a new theme each semester. Projects are introduced by a brief case description about client demands and site conditions etc. The project work is the main curriculum unit which all other activities relate to. Teachers both lecture and supervise in the same room where students work on projects.

Curriculum modalities

With regards to 'epistemic relation' (ER) in each discipline, the curriculum analysis shows a considerable weakening during the period 1967 - 2012. Syllabuses contain increasingly fewer descriptions of content and assessment criteria for each discipline/subject. Rather, the clarification of course content and assessment criteria is done in cooperation among lecturers and through each lecturer's preparation of course lectures.

A curriculum based on single disciplines can therefore not be sustainable. As I have argued, countermoves must be made. One way to act is to implement more open pedagogies such as PBL, which can cope with this. The "old disciplines" are now recontextualised into a 'federation', where content can legitimately be selected for the purpose of the PBL-work, and elements can be left out if they do not have strong enough relation hereto. Legitimizing knowledge now depends more on the involvement of students, their norms, experiences and choices etc. (Maton 2000b), and also how they transverse the subjects in the federation. This federation has then gained more strength in social relation (SR+) and justified the 'knower code' through PBL-pedagogy, as this claims to promote learning which is more suited to the external world.

CAE forms its educational identity strongly through orientation towards the field of practice. Bernstein refers to this as 'projection' (P). The project work is literally close projections of the way students would carry out projects in working life. On the other hand, in the CAE there is, and has always been, a weak orientation towards the intellectual field, correspondingly termed as 'introjection' (I). There is little interest in developing academic knowledge. Focus is put on the practical application of theories (Sarakinioti, Tsatsaroni &

Stamelos 2011). Consequently, the changing modality[iii] of this new federation can be summed up as:

Change specialization codes (single disciplines):	From: ER+/SR-	to: ER-/SR+
Orientation: Introjection/projection:	From: I-/P+	to: I-↓/P+↑

Arrows up and down indicate strengthening respectively weakening. As it can be seen, increasing orientation towards practice (P+↑) does not seem to be contradictory to stronger 'knower code'.

Criticism has been raised to the loss of "epistemic strength" in PBL-work with such strong projection interests. I has been claimed that the knowledge is locked into a specific context and thus not being 'problem portable' (Moore 2011). I will not go further into this discussion here, but in this case it does not seem to be a problem, at least not for the employers of Constructing Architects in the external world.

Transversal knowledge formations in PBL-projects (CAE)

This curriculum modality will then be further transformed in reproduction where the challenge is to make transversal connections between the knowledge fragments. This research is still in progress, but I will highlight some main characteristics of the transversal formations. Here, CAE shows interesting features. During the preparation of teaching, lecturers coordinate lessons from various subjects (Statics, Building Services, Building Design etc.) so that the lessons fit well with the student's project work. Lecturers put the knowledge pieces into position, close aligned, while at the same time leaving 'room' for students to put the pieces together. This could in some ways indicate that lecturers take stronger control over content and communication than the above modality has first indicated. However, interviews and classroom analysis shows a more differentiated picture. In the process of acquiring/reproducing knowledge, there is room for student's reasoning and reflections.

The subjects in CAE share common roots in the sciences, mainly physics and chemistry. As pointed out earlier, science is characterized through a hierarchical knowledge structure (Bernstein 1996). This means that most subjects in the federation can easily integrate in a common language. This is not the case with Nursing Education, which is partially rooted in human knowledge areas. In these areas there is a segmented structure where theories have their own special perspectives and languages.

In CAE the subjects like Statics, 'Building Services' and Building design "speak to one another". Theories and methods can be connected across and almost synthesized without deeper reflection about their relevance, and it is s up to the students to put the pieces of the 'jigsaw puzzle' together (Fig. 6). But to do so requires understanding of the relationship

between theory and empirical representations. This is crucial for the students in order to link or put together the different pieces of the puzzl e from the subjects involved.

Although problem orientation is supposed to be the main principle in the PBL-project work, the problems are not ill-structured. The PBL-project work is about making a product… design a well-functioning building. Thus the task is not to identify what theories to use, but how to apply known theories to the actual type of building, that has to be designed. The students need to acquire factual and procedural knowledge from the subjects and implement it to the actual context.

In developing systemic learning theory from works of G. Bateson L. Qvortrup has termed this as 'first and second order knowledge'. Another theorist, M. Hermansen, conceptualizes it as 'learning levels' which refers to what is reflected in the process (Bateson 1964)(Hermansen 2005)(Qvortrup 2004).

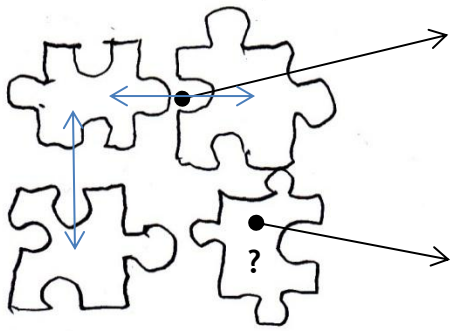
However, applying all the possible theories, methods and techniques from the subjects would cause work overload for the students, so they need to select. This answers the question of what characterizes the strengthening of 'social relation', (SR)? Legitimate knowledge in these projects is not produced purely by mastering methods, procedures and techniques. The project work involves a biographic component. Students define their learning priorities based on what will be beneficial to their study or career perspective. The students justify their choices in a portfolio.

> "So I may write in my portfolio, that I will work more with 'statics' in advance of 'technical installations', but I cannot exclude this entirely. The most important things should be there – for the authorities etc. but I can focus more on one thing than another. In that way you direct yourself through the study how much weight to put on this and that and in what area to specialize"
> (student 3. semester l 269)

It would appear from the above quote that these considerations cannot be purely personal or biographically orientated, because the student must be able to justify the choice 'technically' or "professionally" to some extent… "the most important things should be there". However, reflection on a higher level about the relevance of theories/methods used to analyze empirical problems is not stimulated in this PBL-model, because the 'problem' is not embedded in an ill-tructured societal context. "Building a house in reality" requires building a model of a house as an independent technical reality.

In a sense, connecting various theories and models from the 'federation' of subject "completes" the recontextualization processes, where the students alone are in command of producing the 'theory' of house design. The knowledge gathered from specialized fields is

closely aligned by planners and lecturers, but ultimately it is the students who finally connect them through their learning process. Two types of reflection are dominant: one about the application of theories, and the other about subjective meaning within a career perspective.



Inter-relations are already established because the subjects and their methods are interacting in making a house design product. The students situate the knowledge to the context of the building.

Reflection (Biographic): how theories/methods are relevant in a biographic perspective – what can be left out?

Fig. 5: A 'tight' federation in project work (CAE)
Notes: The "puzzle pieces" represent knowledge from various subjects that have to be integrated to produce a final independent product, i.e. an 'integrated' design project

PBL IN NURSING EDUCATION (NE): "A LOOSE FEDERATION"

PBL as case story

A typical PBL-unit in NE lasts for a few weeks. This unit is then followed by a new and similar one. The PBL-units involve a cluster of disciplines/subjects with 'Nursing Care' being the central discipline. Humanist subjects such as 'Ethics', 'Philosophy and Religion' and so on, are 'supplementary' subjects. In addition, science subjects such as 'Anatomy and physiology' are also included. Each PBL-unit is introduced by the lecturers. They present a study plan and a case story about a patient. Groups of students then work with the recommended texts and receive lessons in the various subject areas. The case work finishes with an oral presentation for the tutor/ lecturer.

Curriculum modalities

Explanation of learning goals and assessment criteria are currently aimed at the federation of subjects rather than at any single subject. As in the case of CAE, the 'knowledge code' for each discipline has gradually become weaker, but it is worth noticing that the science disciplines have kept their epistemic strength through the analyzed period. Today there are

still explicit learning goals and assessment criteria, although they are only found in study plans at lower recontextualization levels.
Although NE's orientation towards the academic field has increased, it still includes both introjection (I+) and projection interests (P+). The following quotes stress this:

> "You might say that it is simply stated in the directives; fundamentally 'Nursing' has two legs: one is orientated to the profession and the other to academic training. It says (directives ed.) that we are supposed to give them that because a bachelor in nursing should have access to academic studies" (lecturer LK l 171)

(Lecturer KN in another interview about PBL):

> "It has to do with the professional basis, because in problem based learning you work with problems. And this corresponds well to the understandings of the Nursing profession. We have lots of nursing-problems to examine and to solve and at the same time – when you think 'problem based' – you reach out for the practical field, get hold of specific authentic cases and by that you can link theory and practice together in a way that we could not before" (l 367)

As in CAE the weakened 'epistemic relation' (ER-) in NE requires countermoves. Similarly this also comes from strengthening 'social relation' (SR+). Students are required to discuss various theories in relation to the case story, thereby challenging their own norms, feelings and experiences. The changing modality can be summed up as:

Change specialization codes:

for humanist areas:	From: ER+/SR-	to: ER-/SR+
for science areas:	From: ER+/SR-	to: ER+/SR-↑
Orientation: Introjection/projection:	From: I-/P+	to: I+/P+

Transversal knowledge formations in PBL-cases (NE)

As in the CAE-case this modality is also transformed in the reproduction processes of PBL-case work. As previously stated, humanist subjects have a more segmented structure as science disciplines. This means that the theories chosen by the team of lecturers often have alternative views to the same problem and the theories do not necessarily "speak together". Furthermore, theories in the nursing field are less instructive and more interpretive. As a consequence, the federation of subjects in NE is more loosely associated than in CAE.
In a PBL case the relationship between theory and empirical representations are of a different nature than in the design projects in CAE. The problem must be subdivided and interpreted: Not only in how theory X can explain problem P1, in the case must be taken into

consideration, but also in how theory X differs from theory Y in explaining P1. Thus, the pedagogical discourse opens for reflections at various levels. However, a 'biographic reflection' as in CAE does not seem to have any significant place in the student's work with the PBL case stories. The following sequence is from a PBL-group's meeting with their tutor (GB):

> GB: "..so it means that these tutor lessons should be used to discuss how we can understand Orem more specifically. How can we develop the concepts so they become understandable for you?
> S1,S2: yes!
> GB:..and how we can transfer the theory and use it in relation to exactly this case story?
> S2: I would really like if we could do this with all three theorists
> GB: Both in relation to…? =>
> S2: both with Henderson and Travelbee and Orem. Well, when I read Orem I felt it related a bit to this Henderson
> GB: it really does =>
> S2: then I would really like a kind of "table" for myself to use at the exam; this is the difference between him and her and…so when you get the case can find out which one to use, what is relevant and how they are different"
> (2. semester line 25 -38)

Even though the lecturers have selected books, articles and other texts, the links between these sources are far from obvious to the students. They are not "pieces" which can easily be put together to reveal a complete picture. The above sequence illustrates that the students seek to understand this relationship. They want clarification about how the various theoretical sources are linked.

The different reflection processes that the students engage in are the kind of "glue" between the knowledge fragments. How such higher order reflections actually occur is the next question. Will those reflections be based on feelings, norms and tacit experiences as a further strengthening of social relations (SR+)? Or, is it possible for the students to build new epistemic relations between the theories and models and higher order concepts by strengthening of epistemic relations (ER+)?

My current research on this particular matter indicates that the student's tacit knowledge and norms are more dominant than explicit epistemic reasoning. However further analysis is needed to shed more light on this.

To sum up, PBL in NE is part of a regionalization process where a federation of subjects is organized and whose relation to one other is up to the students to identify. Here, the

constellation of theories, methods, and principles is segmented due to the application of various scientific perspectives and traditions.

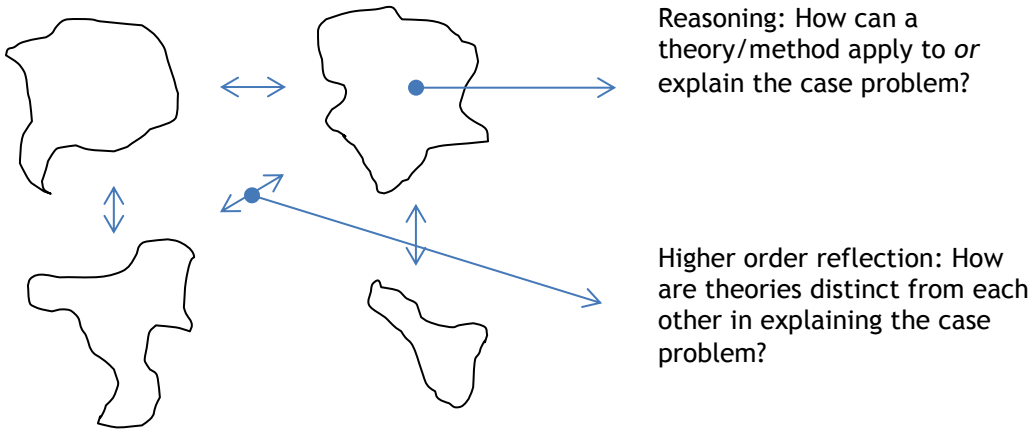


Fig 6: A 'loose' federation in PBL-cases about nursing

Notes: the "pieces" represents knowledge from various subjects or different theories within the same subject. Their relevance to the case-problem must be considered, and then their inter-relations which results in a further level of 'interpretative' reflection than in CAE-case

CONCLUSION AND FUTURE DIRECTIONS

In this paper I have focused on the foundation for 'Transversal knowledge formations' in PBL-work.

The research behind this is based on two institutional cases, 'Nursing' and 'Constructing Architect' educations.

The term transversality has been introduced as an alternative to disciplinarity-terms like multi, inter- and trans-disciplinarity. I have argued that our conception of 'disciplinarity' needs to change because disciplines no longer can be seen as such, due to code changes towards a strong knower code (ER-/SR+). This code change and regionalization are to sides of the same coin. Regionalization processes have generally taken place in higher education over the past several years and 'functionalized" disciplines in regards to demands of the practice fields. However academic demands have also increased for profession bachelor education in the same period and pulled them in the other direction. To meet such different movements and changes PBL has been introduced as a pedagogical framework to embrace those demands. In such a framework, based on constructivist learning ideals, the disciplines can legitimately

'give up' their independence and enter into federal constellations with a relatively strong knower code focusing on ways of knowing rather than states of knowledge (Bernstein 1971s. 60). In the specific NE case, and also generally in Nursing education in DK, educators have attempted to bridge the academic and practice fields while simultaneously striving to achieve a higher academic standing, whereas the CAE education has kept its main orientation within the practice fields.

One important point to note is that PBL is not the main cause of the emergence of this pedagogical environment. In both institutional cases, PBL operates more or less under the conditions of the regionalization which had already taken place before PBL was introduced in either case. Anyhow it leaves room open for new possibilities. Transversal knowledge formations are created through connections made between the federal constellations of subjects in the PBL-courses.

As I have argued, these processes are quite different in each of the two cases. The student's project work in CAE is based on a 'tight federation' whereas in NE the subjects are more loosely related. As I have discussed in the last part of the article, the knowledge cultures in CAE and NE offer different possibilities for reasoning, reflections and abstractions for the students. However these processes need more research into the topic of knowledge building in PBL-work (Maton 2011b)(Muller 2011b). This topic is currently in progress in my Ph.D-project. This article has emphasized the curricular foundation for such knowledge to be built upon.

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PBL and critical thinking disposition in Chinese medical students – A randomized cross-sectional study

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ABSTRACT

The purpose of this study was to explore the relationship of problem-based learning (PBL) and the development of critical thinking disposition (CT) and academic achievement in Chinese medical students using a cross-sectional randomized design. Medical students from China Medical University (CMU) were randomized to PBL or non-PBL teaching at the commencement of the study. After five years of study, CT was scored by a Chinese version of the California Critical Thinking Disposition Inventory (CCTDI-CV). The score achieved on a Computer Case Simulation (CCS) test evaluated academic performance. Total CT score was higher in PBL students (n=170) than non-PBL students (n=83) (304.7±36.8 vs. 279.2±39.4, p < 0.01). Subscale CT-scores were significant in favor of PBL in six of the seven subscales (truth seeking, open-mindedness, analyticity, systematicity, inquisitiveness, maturity). There was no significant difference in terms of gender on the total CT score, though minor differences were seen in subscales favoring female PBL students. PBL students had higher CCS scores than non-PBL students, but not significantly (112.8±20.6 vs. 107.3±16.5; p=0.11). There was no significant correlation between CCS scores and CCTDI-CV results. Male students scored slightly higher on the CCS test compared to female students (male 113.4±18.9 vs. female 109.7±19.7), but the difference was not significant. This study concludes that in Chinese medical students, PBL teaching was related to a higher disposition of critical thinking, but not to improved academic skills.

Key words: academic achievement, Chinese medical students, critical thinking disposition (CT), gender, problem-based learning (PBL)

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INTRODUCTION

Critical thinking (CT) is increasingly regarded as an essential element of educational activities and is defined as a prerequisite skill for health and medical related professions, in particular. CT skills have been designated as one of the desired major learning outcomes of medical schools - as both an academic capability and a professional competence (GMC, 2003; The Tuning Project Medicine, 2005).

Definitions of CT vary and include aspects of psychology, cognition and philosophy. Watson and Glaser (1964) defined CT as a combination of attitude, knowledge and skills. Brookfield (1987) classified four elements of CT: 1) identifying and challenging the assumptions that serve as the basis of ideas, values and actions; 2) challenging the importance of context; 3) assuming and exploring the alternatives; and 4) reflective skepticism. According to Facione and Facione (1996), CT is a nonlinear and cyclical process that allows people to make decisions on what to believe and what to do within a given context.

A quantitative assessment of critical thinking can be used as an instrument to guide education. The California Critical Thinking Disposition Inventory (CCTDI) (Facione and Facione, 1992) was developed to measure students' dispositions towards CT. CCTDI took as its point of departure the Delphi report on CT by the American Philosophical Association Delphi Panel, which defines CT to be "purposeful, self-regulatory judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which judgment is based" (Facione, 1990). Since its development, CCTDI has been well employed to assess student CT disposition and skills in a variety of programs in health and medical education (Leaver-Dunn et al., 2002; Tiwari et al., 2006).

Previous studies not only focused on the measurement and assessment of students' CT, but also on its correlation with academic performance, students' success and so on. Results of these studies have been used in program evaluation and curriculum improvements (Phillips and Rospond, 2004).

Previous scholars have asserted the importance of the learning environment in relation to the development of CT in university students. Problem-based learning (PBL) has been used as a strategy for promoting CT because it addresses the ability to analyze and solve more complex, real-life problems (Oja, 2011). With its theoretical roots in constructivism, PBL has been well used as an educational strategy and method in medical education since late 1960s. By promoting efficient knowledge acquisition, self-directed learning, participation, critical thinking, self-reflection and evaluation, PBL methodology has driven innovative curriculum change and educational reform in many medical universities in the past more than 40 years.

An extensive literature has documented sufficient cognitive evidence to validate the PBL approach to learning outcomes as well as its effectiveness in improving students' clinical performance (Duch et al., 2001; Neville, 2008).

The PBL approach has been described as an effective and efficient strategy to encourage students to improve analytical, problem-solving and collaboration skills (Du et al., 2010), and therefore seems well suited to building critical thinking skills (Oja, 2011). A number of studies have shown a positive relationship between PBL and critical thinking in nursing education (IP et al., 2000; Tiwari et al., 2006; Yuan, Williams and Fan, 2008, Jones, 2008; Oztürk et al., 2008). These studies showed that nursing students in the PBL group scored significantly higher on the CCTDI than students in the non-PBL group.

Despite numerous studies on PBL effectiveness in various aspects of medical education, studies on the effect of PBL on CT skills of medical students remain limited, possibly because of the demanding and complex nature of medical education for both students and teachers. As a consequence, the majority of the CT literature consists of studies on students from the fields of nursing and other health-related study programs. In particular, comparison of PBL and other teaching and learning methods is sparse (Worrell and Profetto-McGrath, 2007). Previous studies have also questioned whether PBL is compatible with the Chinese culture of learning and teaching (Lee et al., 2004) and how Chinese learners may improve critical thinking by PBL (Tiwari et al., 2003). Therefore there is a need for more empirical studies to support the assumption that PBL improves CT in students in health sciences and, in particular, in medicine, in non-Western contexts (Yuan et al., 2008; Oja, 2011).

PBL as an educational strategy has been used in medical education in China since the late 1990s; however, the majority of PBL educational practices have been implemented by individual teachers interested in PBL rather than at the institutional level.

In 2004, China Medical University (CMU) started an educational reform project focused on a systematic implementation of PBL. In 2004, pilot experiments were carried out with a small number of student groups and in the autumn of 2005, PBL methodology was introduced into the majority of the medical study programs at CMU. PBL implementation at CMU has been practiced as a hybrid model (Savin-Baden, 2003) in which diverse teaching methods co-exist. Such teaching methods include clinical cases, lectures in traditional discipline courses, lectures in integrated courses, student group discussions, tutoring and web-based discussions. At the same time, non-PBL programs centered on traditional lecturing and exercise modalities were continued alongside PBL learning, providing a unique opportunity for conducting a randomized controlled trial on the effect of PBL on the learning and development of critical thinking in a complete medical program. Previously, randomized controlled trials have been used to study the effect of PBL and self-directed learning for specific topics such as evidence-based medicine, with the result for PBL being negative in terms of learning outcomes

(Johnston et al., 2009; Bradley et al., 2005). The adoption of PBL by a large Chinese university is interesting from a cultural perspective as it has been speculated that Asian culture does not facilitate self-directed and critical learning, core principles of PBL (Tweed and Lehman, 2002).

The PBL implementation at CMU was dependent on continued interest and engagement in pedagogy reform from both teachers and students. By 2009, more than 1,000 staff and 10,000 medical students had been involved in PBL, with student participation from years five, six, and seven of the programs.

The present study was conducted from 2005 to 2009 to investigate the effect of PBL on CCTDI and academic performance as evaluated by a computer case simulation (CCS) test from National Board of Medical Examiners (NBME).

METHODS

Research questions

The study design was constructed to address the following research questions:

- What is the CT disposition in medical students in a PBL environment compared with those in a non-PBL environment?
- Are there differences between female and male students with respect to the development of CT?
- Is there a difference in CCS grade points between PBL and non-PBL students?
- Is there an association between academic achievement as measured by CCS grade point and CT in PBL and/or non-PBL medical students?

Tools, CT

To estimate CT, CCTDI, a 75-item Likert scale tool, was used to measure students' CT disposition (Facione and Facione, 1992). CCTDI has seven scales: truth seeking, open-mindedness, analyticity, systematicity, CT self-confidence, inquisitiveness and cognitive maturity. Total scores range from 70 to 420, with marks above 280 indicating a positive overall CT. In each disposition scale, a score of 30 or below indicates a consistent negative disposition or weakness in relation to the given attribute or characteristic and a score of 40 indicates a positive disposition for the attribute on average, and a total sum above 280 indicates a positive disposition.

Scholars from Hong Kong Polytechnic University (Peng et al., 2004) developed a Chinese version of the CCTDI (CTDI-CV). Rather than focusing on word-for-word equivalence in the Chinese translation, CTDI-CV is focused on conceptual equivalence to CCTDI (Peng et al., 2004). In consideration of cultural sensitivity, modifications were made. CTDI-CV has been

used as an instrument to study CT in a growing number of universities in China. Due to timing and consideration of resources, the CTDI-CV could not be used at the start of the present study. Therefore, a baseline for CT development is not available and comparisons were only made cross-sectionally.

Tools, Academic Achievement

In 1999, CCS was introduced into Step 3 of the United States Medicine License Examination (USMLE). A Chinese version of CCS was introduced at CMU in 2002 as a major graduate assessment method for five-year and seven-year track students at the end of their fifth year of study. By 2010, 4,000 students had participated in this test. In CMU practice, this test included two stations with random clinical cases. At the time of testing the database contained 80 cases in Chinese, with a time limit set to 20 minutes for each case.

Participants

All students were aged between 18 and 22 years at admission and had high admission grades. The study was conducted among students from the clinical medicine program. Students were enrolled in the seven-year program for a master's degree in medicine in September 2004 (n=270). All students achieved their university placement based on the scores from their National College Examinations. They were evenly and randomly divided into nine classes containing thirty students each. The nine classes were all comparable in terms of students' ages, gender ratio and academic scores in 2004. Beginning in September 2005 (the second academic year), PBL methodology was implemented in six out of the nine classes. The remaining three classes had no PBL implementation.

After 5 years of study, 267 students took the CCS test between September 10 and 20, 2009, and a CCTDI test was conducted on September 30, 2009. The results of these tests were used as the data sources of this study. Out of 267 questionnaires distributed, 256 were returned (female 169 and male 87). Among these, 170 students (female 110 and male 60) from 6 classes had PBL-based courses (PBL students) and 83 students (female 58 and male 25) from 3 classes had no PBL experiences (non-PBL students).

Statistics

Data were analyzed using SPSS 19.0. MANOVA was used to analyze the effects of teaching method and gender on critical thinking scores and CCS scores, with teaching method (PBL vs. non-PBL) and gender as independent variables and CT and CCS scores as dependent variables. A p-value of less than 0.05 was considered significant using Wilks' Lambda in the multivariate analysis. Model assumptions were tested by analyzing data for outliers and using Box's test for equality of covariance and Levene's test for homogeneity of variances.

RESULTS

Students were comparable in age, gender and admission scores. There was a positive effect of PBL on CT scores, as PBL groups showed a total CT score of 304.7 and non-PBL groups a score of 280.4 (see Table 1). Female students scored 307.6 (PBL) vs. 281.6 (non-PBL) and male PBL students scored 299.4 vs. 277.6 for non-PBL students (see Table 1).

The overall multivariate analysis of variance showed a significant effect for learning method (PBL vs. non-PBL) ($p=0.00$, $F=13.02$), but not for gender ($p=0.19$, $F = 1.69$).

Analysis of variance for each group (tests between subjects) showed the overall model to be significant ($p=0.00$, $F= 3901.96$). For the learning method, total CT score was significantly different ($p= 0.01$, $F=23.76$) but the CCS score was not ($p=0.11$, $F=2.57$). For gender, neither the total CT score nor the total CCS score was significant ($p=0.32$ and $p=0.12$ respectively).

Individual components of the critical thinking tests were also assessed by multivariate analysis, including all seven subgroups of critical thinking as dependent variables and learning method and gender as independent variables. The multivariate test showed that the learning method produced a significant difference ($p<0.005$, $F=4.54$) but gender did not ($p=0.34$, $F=1.14$).

For the learning method, analysis of variance for each critical thinking group (between-subjects test) showed all sub-items except self-confidence ($p=0.173$, $F=1.86$) to be significant for all students.

Table 1. Descriptive statistics, showing means and standard deviation of CT disposition scores as a function of teaching method, females and males. For every item in the critical thinking inventory, there is an increased score in the PBL group versus the non-PBL group. * indicates significant difference ($p<0.05$).

	All students		**Female**		**Male**	
Learning Method	Non-PBL	PBL	Non-PBL	PBL	Non-PBL	PBL
N	83	170	58	110	25	60
Truth seeking	38.6±7.1	41.4±6.4*	39.2±7.0	41.5±6.1	37.2±7.2	41.2±6.8
Open-Mindedness	39.8±7.5	44.1±6.3*	40.0±7.6	44.7±6.3	39.5±7.2	42.9±6.3
Analyticity	41.7±8.1	45.2±6.8*	42.3±7.4	45.8±6.1	40.3±9.5	43.9±7.8
Systematicity	38.4±6.8	41.5±7.0*	38.9±6.7	41.0±6.5	37.2±7.0	42.4±7.8
Self-confidence	40.7±9.1	42.0±7.9	41.0±9.0	41.4±8.0	40.2±9.7	43.1±7.7
Inquisitiveness	42.0±9.1	46.5±8.2*	42.2±9.1	46.9±8.2	41.4±9.6	45.7±8.4
Maturity	38.0±8.8	44.2±7.6*	37.8±8.8	44.7±6.9	38.1±9.1	43.3±8.6
Total	279.2±39.4	304.7±36.8	281.4±40.1	305.9±34.3	274.6±43.3	302.5±41.3

DISCUSSION

Results from this study identify a general positive effect of the PBL method on CT disposition in Chinese medical students after their fifth year bachelor program study at CMU. This study observed findings similar to studies on pharmacy students (Phillips et al., 2004) and on nursing students (IP et al., 2000; Tiwari et al., 2006; Oztürk et al., 2008; Yuan et al., 2008; Yuan, Williams and Fan, 2008).

Findings of the present study are consistent with previous research results that PBL has a positive impact on students' learning in terms of CT disposition and its improvement in different social, cultural and discipline contexts (Yuan et al., 2008; Oja, 2011). Positive CT disposition results of PBL-students can be attributed to the characteristics of this method. Using problems as a starting point for learning can potentially increase curiosity and eagerness to acquire knowledge and explore reasons and explanations. When starting from problems, students must develop self-directed learning strategies, which may help to improve their ability to relate theory to practice, analyze, evaluate, judge, conclude and make decisions (Hmelo and Lin, 2000). Group discussion and teamwork provide good opportunities to be open to a variety of opinions, and thus develop an increased tolerance for other's viewpoints. In the process of managing self-directed learning through teamwork, students improve their maturity (Schmidt and Moust, 2000).

As reported in the results, the PBL group scored positive (above 40) on all the seven subscales of CCTDI. The non-PBL group scored positive (above 40) on four of the seven subscales: open-mindedness, analyticity, self-confidence, and inquisitiveness, and scored negative (below 40) on three subscales: truth seeking, systematicity and maturity. The PBL group scored significantly higher than the non-PBL group, which may be an effect of employing the PBL methodology.

The PBL group demonstrated significantly higher scores than non-PBL students in six out of the seven subscales: truth seeking, open-mindedness, analyticity, systematicity, inquisitiveness and maturity. This is consistent with other results involving Chinese students (Ip et al., 2000; Marcia et al., 2003; Yuan et al., 2008; Tiwari et al., 2006).

Lower scores in truth seeking and systematicity were also found in previous studies of nursing students studying in lecture-centered environments in the U.S., Australia and Japan (Kawashima and Petrini, 2004; Marcia et al., 2003). This is consistent with the summary of PBL effectiveness on critical thinking in comparison with lecture-based study environments (Oztürk, 2008; Oja, 2011).

This study also mirrors previous studies (Ip et al., 2000; Marcia et al., 2003; Yuan et al., 2008; Tiwari et al., 2006) concerning the subscale self-confidence: the score did not differ

significantly between the PBL and non-PBL groups, although both groups scored positive (above 40). To a certain degree, this may indicate that there are other factors that have not been included in this study influencing students' self-confidence or that self-confidence is not as closely related to CT for this study group as the other subscales in the inventory are.
A previous study documented a correlation between CCTDI scores and academic performance (Yuan, Williams and Fan, 2008). However, the correlation between CCTDI and CCS results was not significant in this study. It is interesting to note that PBL did not have a positive effect on academic performance, as this corroborates emphasizes previous skepticism of using PBL in China (Lee et al., 2004). However, further investigation is needed to examine the correlation between CT and academic performance.

Results of this study identified no statistically significant gender differences either in relation to CCTDI or to academic performance based on CCS scores, except for a small advantage for male students in the CCS test. This finding echoes previous studies in which no overall gender difference could be found in relation to CCTDI results (Yuan, Williams and Fan, 2008).

CONCLUSION AND PERSPECTIVES

In summary, the PBL environment as organized at the Chinese Medical University had a positive impact on CT disposition and may improve performance of Chinese medical students. This study suggests that medical education in general is challenged by new demands. Changes in the demands of the medical profession make critical thinking an increasingly important competence. The random allocating of students to classes in which teaching methods are different can potentially impact students' learning; nevertheless, evidence-based approaches to educational experiments and innovation are important. The implementation of educational innovation is done in a multi-professional environment where relational skills and organizational understanding are crucial. Furthermore, longitudinal follow-up studies on the medical careers of students from both groups of students will later show whether the different learning environments and increased disposition towards critical thinking has an effect on postgraduate performance. Follow-up investigations on patient treatment outcomes for each group of future medical doctors could complement this study.

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Declaration of Interest

The authors report no declarations of interest.

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The potential improvement of team-working skills in Biomedical and Natural Science students using a problem-based learning approach

*Forough L. Nowrouzian and Anne Farewell **

ABSTRACT

Teamwork has become an integral part of most organisations today, and it is clearly important in Science and other disciplines. In Science, research teams increase in size while the number of single-authored papers and patents decline. Team-work in laboratory sciences permits projects that are too big or complex for one individual to be tackled. This development requires that students gain experience of team-work before they start their professional career. Students working in teams this may increase productivity, confidence, innovative capacity and improvement of interpersonal skills. Problem-based learning (PBL) is an instructional approach focusing on real analytical problems as a means of training an analytical scientist. PBL may have a positive impact on team-work skills that are important for undergraduates and postgraduates to enable effective collaborative work. This survey of the current literature explores the development of the team-work skills in Biomedical Science students using PBL.

INTRODUCTION

Biomedical and Natural Science compromise many undergraduate degree programmes. They are partly a practical discipline covering a broad knowledge and practice within Science, and they encompass many technical skills which students will use during their education. The ability of the students to master the principles of analytical knowledge is of great importance in their progress within a chosen educational field.

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The term "team" in literature has been defined as a special group of people working interdependently to achieve a goal (Levi, 2010). Teams are a ubiquitous part of most organizations today. Students accordingly need to gain experience of working in teams before starting their professional career. Teamwork is increasingly important in Science and other disciplines. The numbers of single-authored papers and patents are declining and the size of research teams is increasing, particularly in Medical Science and other related educational fields. In these occupations it is common to have a project which is too big or complex for one individual. For these reasons, teaching methods which improves the students' ability to work in teams are highly desirable.

A great number of university teachers, especially those in the laboratory sciences and related areas, have been using teams in different ways in their courses/classes such as short-and long-term projects and, in addition, it is common for students to work in the laboratory in teams of two people. Benefits of group projects include an increased understanding of group dynamics, an improvement of interpersonal skills and a potential exposure to diverse opinions (Alkaslassy, 2011; Mello, 1993). It accordingly increases productivity, confidence and innovation (Wuchty, Jones, & Uzzi, 2007).

Problem-based learning (PBL) represents a principal change in educational practice within higher education, and it is today an established method of education for medical, health care and analytical Science, world over (Dolmans, De Grave, Wolfhagen, & Van Der Vleuten, 2005). There are many variations on PBL, however the traditional definition emphasises on the learning which comes from the understanding of, or resolution of a problem. In fact, the problem is encountered first in the learning process (Barrows & Tamblyn, 1980). PBL can be very strictly defined as a purely student-centered approach with minimal teacher guidance or a more mixed approached where the teacher guides the process to a greater or lesser degree (Smith, 2005).

LEARNING THEORY UNDERLYING PBL

The learning theories behind successful PBL have been extensively reviewed and discussed for more than 20 years e.g., (Schmidt, et al, 2009; Thurley & Dennick, 2008; Springer, et al, 1999). Briefly, PBL is based on four learning principles. These are that learning is 1) a constructivist process 2) self-directed 3) social and collaborative; and 4) a contextual process (Dolmans, De Grave, Wolfhagen, & Van Der Vleuten, 2005).

Learning should be a constructive process; learning is an active process in which students actively construct or reconstruct their knowledge (Biggs & Tang 2007). The students´ competences will be developed through participating actively in discussion, note-taking or answering questions, and generally talking about a subject. This process plays an important

role in activating prior knowledge and then relating it to the new information. In other words, learners should be involved actively and should be stimulated towards activation of prior knowledge that may lead to deeper and richer understanding and better use of knowledge.

Learning should be a self-directed process; PBL is student centred and based on an active role of the group members. Students should actively participate in planning, monitoring and evaluation of the learning process (Ertmer & Newby, 1996). PBL requires students to take responsibility for their learning, and if they are not motivated to study in an independent way it will impact the progress of the PBL group. Thus motivation plays an essential role in promoting self-directed progress (Pintrich, 1999).

Learning should be a social and collaborative process; PBL is normally carried out within small groups in which two or more people interact with each other; students work together in a team to achieve a common task. However, collaboration is not always a matter of division of tasks among learners i.e. it may involve mutual interaction and a shared understanding of a problem. Thus, they talk, communicate, interact and collaborate (Reimann & Spada, 1996). The social nature is an important trait of PBL and it has been suggested that cooperation leads to more effective problem-solving skills than competitive learning (Qin, Johnson, & Johnson, 1995).

Learning should be a contextual process; Contextual learning theory also relates to constructivism. Learning in a context may support storage and recall of knowledge more easily. In other words, learning is situational and the situation in which knowledge is acquired determines the effective use of this knowledge (Billet, 1996).

Even though PBL may differ in various institutions, it will always be characterized by three features: a) problem as stimulus for learning, b) tutors or teachers as facilitators and c) group work as stimulus for interaction (Dolmans, De Grave, Wolfhagen, & Van Der Vleuten, 2005).

Problem as stimulus for learning; problem refers to a scientific case which should be explored during the course. Students first analyse the problem, decide what they already know about it and then what they need to figure out. Hence they determine what questions are relevant to their enquiry and what actions they need to take. The team members then work independently and research different aspects of the problem before bringing their finding back to the group and to the tutorial session in order to co-construct new knowledge.

Teachers as facilitators; the teacher's main role is to facilitate the tutorials in which they can evaluate student learning, develop students' problem-solving skills and promote critical thinking (Barrows, 1988). The teacher as facilitator role is not to transmit information but rather to facilitate self-directed learning.

Group work as stimulus for interactions; in PBL, problems are discussed in a small group in which students learn from each other by asking and answering questions and by discussing the case which should be explained. Thus the students learn to work together which may help them to become better collaborators (Hmelo-Silver, 2004).

It has been generally assumed that PBL has positive effects on team-working abilities i.e. it prepares students to work with colleagues from different occupations and enhances their knowledge of team work in different aspects. However, research into the impact of PBL on development of team-working skills is limited. The aim of this paper is to review the current literature and discuss the possibility that PBL has the potential to prepare students to work more effectively in teams than other teaching methods, particularly in the natural sciences.

TEAM-WORKING SKILLS AND PBL

PBL was begun in the medical schools and other related occupations as an alternative learning method many years ago, reviewed in (Allen, Donham, & Bernhardt, 2011; Seymour, 2011). It is an approach to learning which can be implemented over a complete program or applied to specific sections.

A problem arises however, in assessing the effect of using PBL compared to traditional, lecture based methods. As mentioned above, the implementation of PBL varies widely from course to course. For example, the case study approaches, although not traditionally a PBL approach does often include many of the features of PBL such as teamwork, problem solving and discussion. One must look carefully at individual reports to determine which variant of PBL is being studied. A second problem that arises is contextual. It is clear from the literature that skilled tutors or facilitators have better outcomes than unskilled tutors. Individual student groups also may have more or less success with the methodology. It has been argued that because a change to a PBL format changes so many variables, that simple comparisons to traditional methods will be ineffective (Dolmans & Gijbels, 2013; Norman & Schmidt, 2000).

Overall, however, positive outcomes for PBL are noted, firstly, with student satisfaction or interest, and to a lesser degree with long-term application of knowledge e.g., (Albanese & Mitchell, 1993). What is often also cited is that PBL increases the students' ability to work in teams. Although this is a commonly desired skill by employers, it is vaguely defined, therefore effort has been made to define it more precisely.

Skills which are essential for working within a team can be divided into two categories: task-directed skills which focus on to completing the final product, and socio-emotional- oriented skills which are involved in maintaining the team processes (Prichard & Stanton, 1999). The first category consists of the skills in searching for relevant information, resource investigation and planning. The second category comprises the skills such as the ability to

deal with conflict, support and encouragement of others and communication within team and between teams (Wheelan, 2005).

The importance of the team member personality on the team effectiveness has been debated (Driskell, Goodwin, Salas, & O´Shea, 2006), the matter is quite complex and its explanation depends on the definition of personality and effectiveness. However, many studies have attempted to define the relationship between team-member personality and team effectiveness. The following personality characteristics: emotional stability, extraversion, openness, agreeableness, and conscientiousness have been related to team success (Barrick, Stewart, Neubert, & Mount, 1998; Barry & Stewart, 1997; Hollenbeck et al., 2002; Neuman & Wright, 1999). Furthermore, Cannon-Bowers et.al. have integrated a great range of studies and have proposed that eight features are needed for effective team work, i.e. adaptability, team awareness, performance monitoring and feedback, team management, interpersonal relations, coordination, communication and decision making (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995). Within these dimensions lie many task-oriented and socio-emotional skills and behaviours. These complex skills however, do not develop by simply gathering students in groups to work on projects (Prichard & Stanton, 1999) but these skills are likely improved when students are practicing them in an appropriate learning program such as PBL.

Communication and negotiation are common social skills practiced within PBL. When you are working together as a team to reach the same goal it is really important that you can negotiate with each other, communicate what you can bring to the team and what others can bring to the team as well. To learn through PBL you need to be able to speak up otherwise you are not really contributing and you should also have an opinion and not be afraid to give it. The ability to make decisions and time management are task-orientated skills that often improve through PBL (Seymour, 2011).

Although it may seem obvious that giving the students the chance to practice working in a team in the more protective atmosphere of the university should have a positive effect on the students' ability to work in teams in the future, direct evidence for this is sparse. In large part this is likely because it is difficult to measure team-working skills. The few studies that have directly addressed the impact of PBL on team-work are generally positive however.

A qualitative study undertaken by Stern et al. (Stern, 1996) in therapy education that was based on group interviews, individual interviews and course evaluation questionnaires has shown that PBL enhanced the personal behaviours such as interpersonal communication and team work. The course was short (a seven-week course) and thereby probably not long enough to give an appropriate evaluation of PBL effects. Although, another report investigating a full PBL program suggested that PBL contributes to development of communication and team-building skills, information management, critical reasoning and

students are trained for an effectively collaboration with colleagues from different professional groups (Hammell et al., 1999).

Some studies have suggested that graduates of PBL medical schools have better interpersonal abilities, communication and the team-working abilities and also some task-specific talents such as planning and organisation and leadership (Prince, Van Eijs, Boshuizen, Van Der Vleuten, & Schuerpbier, 2005). Notably, non-hierarchical nature of PBL group is an important character that prepares an environment where group members feel safe to practice new team-working skills. Students' confidence and critical thinking will accordingly be improved (Seymour, 2011).

Several researchers have looked at self-reported outcomes of PBL-based medical education and saw significant effects on teamwork. Prince, et al (Prince, et al., 2005) surveyed a large number of graduates of medical schools in the Netherlands and found the young doctors reported significantly better preparation in the areas of profession-specific skills, communication and teamwork if they had attended a PBL programme. Watmough, et al (Watmough, Cherry, & O'Sullivan, 2012) reported that medical school graduates reported being significantly better prepared for teamwork than their traditional counterparts in a British study done 6 years after graduation. Similarly, a study by (Schlett et al., 2010) of graduates of medical schools (8-10 years after graduation) in Germany using PBL felt they were better prepared for several professional skills, such as teamwork, than did graduates of conventional medical schools.

FUTURE PERSPECTIVES

One area where the increase in teamwork in a PBL setting could be very useful and is generally underutilized is the laboratory. At our university, natural science and biomedical undergraduate and postgraduate students have a great deal of laboratory classes (as much as 20 hours/week). Students are usually organised in a team with 2-4 members, working together during the laboratory. According to the layout of the laboratory experiments the different tasks are distributed between the team members. Thus, the use of a learning method that improves the team-working skills would be very useful.

Often students complain that the laboratory programs are dull and it is difficult to connect the theoretical concepts to the laboratory experiences. Many of the experiments in our laboratory program are not experiments; they are determination of a question. Other laboratory exercises are demonstrations designed to simply illustrate some aspect of an analysis. Thus, the outcome of the laboratory work did not influence intellectual interest of students but only affected their grade.

One approach to address these concerns are inquiry based laboratories which are closely related to the PBL approach. Inquiry based laboratories start with the problem and require the students to think about the problem, design experimental approaches and then do the analysis. They are generally a more guided form of PBL due to practical limitations. Studies have shown that inquiry laboratories have increased student motivation and better student outcomes e.g., reviewed in (Wood, 2009). If one made an effort to include more PBL type group work structure in the inquiry based lab, one might be able to increase the students' ability to work in teams as well. One example of this approach is described in (Larive, 2004) where a business-like approach to hiring students into group roles was utilized. As mentioned in the introduction, team-work has become the standard in modern biomedical research and improving our students skills in this area would improve their future prospects.

CONCLUDING REMARKS

Data on the impact of PBL on the development of team-working abilities is limited. Most studies are qualitative and they do not give a comprehensive description of how these skills are developed (Norman & Schmidt, 2000). The difficulty with evaluating the effectiveness of PBL may be due to the fact that it is not only regarded as a teaching method but also as a philosophy of teaching thus it is practised differently in various institutions (Norman & Schmidt, 2000). Thus, it is difficult to compare data gathered from one program or course with another see e.g. (Dolmans & Gijbels, 2013) for a discussion of some of these issues). However, the studies that have been conducted indicate a generally favourable effect on team-working abilities when students are taught in a PBL environment.

In conclusion, this work focused on collecting data from current literatures regarding development of students' personality and professional team-working skills through using PBL. There was a great agreement that PBL enhances communication, negotiation, collaboration, independency, confidence, making decisions, management and organisation skills. Since these characters are prerequisites for the effectiveness of a team. PBL is accordingly an appropriate learning method especially in analytical educations in which the team working is fundamental.

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Coaching tutors to observe and regulate leadership in PBL student teams or you can lead a horse to water but you can't make it drink…

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ABSTRACT

The purpose of this paper is to investigate how PBL student teams develop specific leadership configurations when implementing interdisciplinary projects and whether or not tutors help in dealing with the group interactions that are subsequently generated. The data set was drawn from 2 cohorts of first-year students engaged in PBL activities in an engineering school in Belgium in 2011 and 2012. Following qualitative content analysis of tutor and student feedback and the use of sociometric testing, findings for 2011 showed that students developed 4 specific leadership configurations, each of them being positively correlated to specific perceived work outcomes. Findings for 2012 were based on using the sociogram as a pedagogical tool to enable tutors to describe and regulate group dynamics. We found that tutors positively perceive their role in facilitating production outcomes but are more uncomfortable when it comes to regulating the interpersonal problems that arise in student self-managed teams.

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INTRODUCTION

To understand how students learn in problem-based learning settings (PBL) requires investigating a number of issues as they relate to its design, implementation and evaluation. For Johnson & Johnson (1991, 1998), the efficiency of learning within student groups depends on the degree of positive interdependence generated as well as on recognizing the importance of individual responsibility. However, putting students in groups and giving them a problem to solve does not guarantee that they will learn and understand the rules of the group in the learning process. The 'natural' tendency of a group in charge of a project is to distinguish between tasks and to specialize in topics, with the group organizing itself to reach the solution. Interpersonal problems may interfere with achieving objectives, giving rise to unequal collaboration by group members (Oakley et al, 2007) and divergence as regards commitment (Wilkerson, 1991; Duek, 2000).

Effective collaborative practices among students may be enhanced when the role of tutors is designed to enable them to critically engage with the learning issues that emerge with PBL approaches (Albanese & Mitchell, 1993). This requires tutors who are trained to facilitate (Raucent et al, 2009) rather than to be 'the teacher in front of the class', a role which newcomers to PBL find difficult to take on. A further issue concerns the approach used to measure collaboration practices and production outcomes. Recent research has shown that although individual assessment tools are no longer deemed sufficient in such settings (Holgard & Kolmos, 2009), the move towards using group assessment tools is still in its infancy. A final issue is that of leadership learning in student teams, where the practice of the shared leadership concept (Barry, 1991) has been positively correlated with team performance (Sivasubramaniam et al, 2002). However, there is as yet little empirical research in academic settings dedicated to examining the impact of teamwork structures on student team performance and learning.

The purpose of this paper is to explore the roles that tutors play in influencing group dynamics created by students when implementing PBL projects. What is the nature of tutors' inputs? How do they understand the leadership configurations manifested in the groups? Do they regulate these leadership configurations and if so, how? The setting used is a PBL project implemented at Ecole Polytechnique de Louvain (EPL) in Belgium. This project, implemented since the year 2000 for first year students, focuses on PBL in three academic disciplines and collective working on an interdisciplinary project (Frenay et al, 2007). The project aims to facilitate learning from a concrete experience through applying the knowledge and techniques acquired through disciplinary problem-based learning, as well as to enhance teamwork skills and to initiate leadership roles.

The paper is structured as follows. The literature review examines student collaborative behaviors, tutor roles and attitudes, assessment practices and leadership configurations as they

relate to PBL in student teams. The methodology, based on qualitative content analysis of student and tutor feedback on perceptions of teamwork processes and performance in the projects carried out in 2011 and 2012, is then presented. This is followed by a presentation of the results obtained, enriched with a set of conclusions.

LITERATURE REVIEW

PBL design promotes socio-cognitive constructive conflicts and collaboration

In his review of problem-based practices within educational theory, Gijselaers (1996) highlights three main principles regarding learning :1) learning is a constructive process, 2) knowing about knowing affects learning, 3) social and contextual factors affect learning. More precisely, Kolmos, De Graaf and Du (2009) found three common learning principles that cut across the different forms of PBL : 1) learning is organized around problems and carried out in projects so as to enhance motivation of students, 2) contents of problem link practice to interdisciplinary theories and is exemplary of overall objectives of curriculum, 3) learning takes place in teams where students learn from each other, share knowledge and are collectively responsible for the learning process, especially the formulation of the problem. The argument for using socio-cognitive conflicts within a team of students originates in the observation that many students have difficulties in using scientific language or have erroneous beliefs. PBL places students in small collaborative groups as a means of confronting them with alternative views of prior knowledge as well as with different problem solving methods. It is argued that experiencing socio-cognitive conflicts among peers helps them overcome false preconceptions by sharing ideas, sharing responsibilities in managing problem situations, leading them to ask new questions (Glaser, 1991, Mandl, Gruber and Renkl, 1993, Bruning, Schraw and Ronning, 1995 cited by cited by Gijselaers, 1996).

We know from educational research that cooperation and collaboration are not automatic student behaviors. More often students either show competition against each other (who is the best performer?) or individualism (work for themselves without paying attention to others), (Johnson & Johnson, 1991). Johnson & Johnson (1998) explain that five conditions are necessary for cooperation to arise: perceived positive interdependence between members (each one understands the task and learning will not occur unless everyone contributes to it), face to face interaction, individual commitment and responsibility, interpersonal skills, and frequent group process follow-up for better functioning in the future. The benefits of cooperation are clear: better production, better learning and also more friendship and higher tolerance for differences in knowledge and abilities among students. According to Roschelle and Teasley (1995), collaboration goes further than cooperation. While cooperation can be achieved through mere coordination of independent tasks, collaboration requires "a joint problem space" where students communicate with each other so as to share the definition of the problem, the goals that they want to achieve, and the actions that are available and that they choose for problem solving. In this collaborative perspective, Kolmos, De Graaf and Du

(2009) argue for PBL alignment among 7 elements of pedagogical design: objectives of knowledge, types of problems and projects, progression and size in curriculum, students' learning, academic staff and facilitation, space and organization, assessment and evaluation. Amongst these 7 elements, the open-problem based and learner-centered approach of PBL refers to 3 elements focusing on collaborative behaviors within a team: tutor's facilitation and process guidance, group assessment and formative evaluation and student's collaborative behaviors.

The tutor's role and attitudes should facilitate collaboration, but…

In PBL literature, a major concern is the role of tutors (Albanese and Mitchell, 1993). Their attitude is seen as a critical factor which impacts students' ability to raise relevant questions and critical learning issues (Williams, 1992, Wikerson, 1995 cited by Gijselaers, 1996). Collaboration can be facilitated if the problem is sufficiently challenging and if the tutor correctly balances a set of various roles (Bouvy, De Theux, Raucent, Smidts, Sobieski, Wouters, 2010). For some researchers, it is also up to the tutor to create groups so that likes and dislikes are optimized as well as to teach students interpersonal skills (Jacques, 2000). The tutor can act as a role model, demonstrating new behaviors towards others, to which students might not be accustomed (Duek, 2000). This role will be effective if tutors show "social and cognitive congruence", that is to say a friendly attitude and the ability to translate knowledge into accessible terms for students (Schmidt and Moust, 1995, 2000).

However, students and tutors appear to lack the necessary vocabulary and knowledge to observe and reflect on real collaboration. Tipping, Freeman and Rachlis (1995, cited by Faidley, Salisbury-Glennon, Glenn and Hmelo, 2000:112), observed a significant gap between tutors' perceptions of PBL teamwork and evidence from videos of the same groups. Raucent, Hernandez and Moore (2009) show that it is very difficult for teachers acting as tutors to observe their own practices objectively and to critically analyze them. Thus it appears that all PBL actors lack indicators to assess what really happens in team collaboration.

Group assessment and formative evaluation: a necessary but complex tool to use

Recent research in PBL expresses concerns regarding the alignment between objectives, activities and assessment as far as collaboration is concerned. A longitudinal survey comparing group and individual PBL assessment in Aalborg University (Hoolgard and Kolmos, 2009) makes this clear. Students, faculty and external examiners find that individual exams test only a limited range of skills compared to group assessment. The latter proved more effective in testing skills related to problem solving, methodological argumentation and theoretical overview and even more so regarding the ability to transfer and transpose knowledge from one area to another. Although group assessment was preferred by the majority of students as well as by faculty and external examiners, authors also observe that individual assessment tools are much more commonly used than group assessment tools.

Another study tested the effectiveness of a portfolio as an assessment tool in a project-based course in electric and electronical engineering (Stojcevski and Du, 2009). Results show that the portfolio is effective in respecting constructive alignment imperatives, but does not account for certain learning outcomes, specifically those regarding collaboration, like project management skills, teamwork skills and understanding of PBL. Another study presents a very interesting assessment tool of collaborative teamwork using peer assessment in a project-based program in engineering (Doucet, 2004). Students evaluate each member's contribution, as compared to their own, using five criteria (initiative, creativity, perserverance, efficacy, ponctuality). The advantage of the tool is that it enables teachers to discriminate collective grades according to the effective contribution of students. But it is not very clear whether students collaborated or simply cooperated. In this faculty, such a practice was accepted by students but compilation of data highlighted rather complicated issues in a different cultural context: French students showed resistance in using this tool when the group had experienced problematic relationships (Verzat, 2009:34). So the tool does not help in understanding processes leading to effective collaboration and how this can be improved.
Drawing on these studies, it appears that assessment tools of collaboration in PBL need more studies to reach consensus on criteria and ownership of assessment, especially when groups encounter problematic relationships between members. Indeed many studies show that collaborative behaviors in PBL groups cannot be taken for granted.

PBL research on students' collaborative behaviors reveals inequality between members and groups.

Although PBL groups are designed to promote collaboration between students, evidence shows that it is not present to the same degree in all groups. Assessment of a project-led program with engineering students in Portugal shows that time, task management and motivation are particularly problematic in teams (Fernandez, Flores and Lima, 2009:52). Other research results also report interpersonal problems in student group-work, due to insufficient trust between members (Huff, Cooper and Jones, 2002, Bianey, Ruiz and Adams, 2004), free-riders (Oakley, Hanna, Kuzmyn, and Felder, 2007), racial and sexual discrimination (Cox, 1996, Faidley et al. 2000), or insufficient ownership (Wilkerson, 1991, Duek, 2000, Wood, 2003).

Cohen (1994), cited by Wilkerson, 1996) concludes that complex, verbalized thinking and social skills will not be displayed automatically by students in groupwork. They have to be trained in those skills. We found three studies that explore students' roles, interaction behaviors and socio-emotional quality within PBL groups. Duek (2000:92) analyzed videos and interviewed tutors and students from 2 sessions of 3 PBL groups in a first-year medical curriculum. Her analysis highlights students' "group functioning roles" and students' "group processing behaviors" which refer to interaction behaviors based on Benne and Sheats' (1978)

categories[1]. She found that there were notably consistent roles played by students: the "discussion dominator", the "holistic big-picture" or "hyper-contributing" student, and the "referencer and silent scribe".

Those roles might contribute to building specific group dynamics observed by Faidley et al. (2000) who analyzed videos of PBL sessions in medical curricula and addressed questionnaires to 20 first-year students of those sessions. Borrowing questions from a survey instrument (CWG Survey, Connolly and Wilson, 1992), they built a "Learning Team Survey[2]" that assesses individual and group perceptions of process and performance. They also elaborated a checklist of the 6 most frequently observable substantive and group processing behaviors[3] with 15 experienced PBL facilitators. Their results describe four types of groups: 1) the Teacher-Dominated or Socratic group, 2) the Student-Negotiated or Transmission group, 3) the Single-Student Dominant or Cautiously Interactive group and the 4) Male dominant or Aggressively Interactive group. Students' perceptions of overall team satisfaction measured by LTS survey, show that model 2 is very satisfactory for all members, model 1 and 3 show very unequal results among the different members, while model 4 is mostly unsatisfactory.

Satisfaction and emotional factors appear be an important feature of groups. An interesting research program on engineering students in PBL programs in Belgium assessed the links between the socio-emotional quality of groups (SEQ) and team members' perceptions of success in having acquired cognitive and interaction skills. SEQ accounts for the level of trust between members and how well they get on with each other. Results indicate that SEQ develops very quickly among a newly formed group of students. It has a strong impact on task performance (Buelens, Van Mierlo, Van der Bulck, Elen and Van Avermaet, 2005), but is only weakly affected by the students' appreciation of what was learned with regard to solving engineering problems and even with regard to acquiring social skills (Heylen, Buelens, Vander Sloten, 2009).

As we can see through those studies, group processing roles, behaviors and emotions are interdependent. Domination by one student or by an authoritarian tutor seems particularly unpleasant and leads to dissatisfaction, poor dialogue and performance. A contrario, perceptions of equality between members and of cognitive but also emotional fit appear to be essential conditions of collaboration between students. But clear indicators of what can be

[1] The possible group processing behaviors are the following : aggressing, derailing/blocking, encouraging/energizing, facilitating/orienting/claryfing, forwarding/initiating/contributing, gatekeeping, hypercontributing/dominating, hypocontributing/withdrawing/following, Observing/participating peripherally, Overtalking, Placeholding, Recognition seeking, Undertalking.

2 This survey comprises 38 questions statistically checked as 7 validated constructs : commitment to purpose, commitment to common approach, complementary skills, accountability, team conflict, team performance, overall satisfaction.

[3] The substantive behaviors are : practice of connecting principles of basic science to case under study, practice of assessing what knowledge is needed to understand the case under study, practice of hypothesizing from a particular set of facts concerning a case. The group processing behaviors are : practice of relatively equal participation of group members, practice of questioning or challenging information or reasoning processes of group members, practice of recognizing contributions of individual group members (complimenting, encouraging, etc…).

regulated by tutor or group members and who assumes ownership for group regulation is not clear. Leadership research can help dealing with this subject.

Another way to explore collaboration in PBL student teams: leadership roles

In self-managed teams, like student teams, there is no formal hierarchical authority. Researchers in social psychology (Levine & Moreland, 1990; McGrath, 1984) and organizational behavior (Bettenhausen, 1991; Sundstrom et al., 1990) explain that team members in such teams need specific interpersonal and self-management skills to perform best. Stevens and Campion (1994) produced a framework of those skills[4]. But a self-managed team's performance is not automatically raised by the presence of skilled individuals. Marks, Mathieu, & Zaccaro (2001) demonstrated that three categories of group processes moderate the impact of team design on group performance in self-managed teams: transition processes, action processes, and interpersonal processes[5].

Those processes require leadership envisioned as a collection of roles or functions that can be held by one or several members. At the individual level, the leader is usually defined as "the individual most likely to direct the activities of other team members" (De Souza & Klein, 1995: 475). But as Barry (1991) pointed out, in the absence of formal authority, self-managed teams are potentially more vulnerable to conflicts and power struggles, and are more inclined to "fission rather than fusion" (ibid.: 32). Envisioned as "a set of functions to be supported by the group" (Gibb, 1954: 884), leadership in self-managed teams may be conceptualized as a "collection of roles and behaviors that can be distributed, shared, swapped, both sequentially or simultaneously" (Barry, ibid.: 34). "Exercising the right role at the right time" seems to be the winning formula, with four leadership roles stressed by Barry. **1) Envisioning leadership** facilitates idea generation and innovation, through setting ambitious goals and identifying links between ideas or systems. **2) Organizing leadership** is concerned with sharing and controlling efficient and effective task completion. These leaders bring together and order disparate elements, with attention to detail, deadlines, and structure**. 3) Spanning leadership** links the team to its external environment through active networking behavior, team image and reputation promotion, while **4) social leadership** allows members to express their needs and concerns, and it ensures that everyone can express his/her opinion.

Drawing on Barry (1991) notion of leadership roles, our purpose in this research is to investigate how PBL student groups develop specific leadership configurations and whether or not tutors help dealing with this issue. Are they aware of the group dynamics at stake? As tutors seem to have difficulties in describing and assessing effective collaboration (Tipping et

[4] Interpersonal skills refer to the ability to manage conflict, to solve problems collaboratively, and to communicate within and outside the group. self-management skills consist in the ability to collectively choose work objectives and track the group progress towards these goals through effective planning and coordination tasks.

[5] The transition processes consist in formulating the group strategy and choosing the objectives to be pursued. Action processes refer to monitoring the group activity in its effort to achieve the objectives, as well as coordinating individual contributions to collective action. Interpersonal processes refer to conflict and emotions management, as well as motivation and confidence building

al.1995, Faidley et al. 2000, Raucent et al., 2009), what kind of tool could help them progress in that field?

RESEARCH DESIGN AND METHODOLOGY

The research context

Using the setting provided by the PBL project work carried out at the Ecole Polytechnique de Louvain, we studied two cohorts of first-year students over two consecutive years (2011 and 2012). In the first week of the school year, a 'kick-off' game such as 'Spaghetti à la Kolb (Kofoed, 2003; Raucent et al, 2007) is proposed to enable students and tutors to begin reflecting on collaborative learning. Students also receive extensive tutor support to help them reflect on group work and in particular on the importance of rotating roles such as time keeper, moderator, secretary and scribe. Normal school activities begin in week 2. This includes problem-solving in mathematics, physics and computer engineering and a 12-week interdisciplinary project. The tutors play a particular role in facilitating all activities (Raucent et al, 2009) and are present with the teams at regular intervals throughout the weekly meetings. Each week, groups have to provide an assessment of the group relationship and report on this subject after the preliminary jury (week 5/6). The tutors provide feedback on the quality of the group work and are expected to instigate group reflection practices. Controversial exchanges are encouraged to enable the students to gain self-confidence in their teamwork effectiveness, particularly as regards leadership distribution. The tutors are PhD students in engineering domains. Some have followed the EPL curriculum and have therefore experienced PBL and project work as students. Some come from other institutions and they do not necessarily share the same idea of what PBL is. In 2011, the student intake was 360 (60 groups) and in 2012, there were 62 groups.

Data collection and analysis

To identify group interactions, leadership distribution and tutor behaviors, we collected and analyzed the feedback provided by students and tutors, using qualitative content analysis. The methodological approach included the following 3 phases.

Step 1: Discovering leadership configurations through analysis of students' 2011 qualitative reports

Two sets of documents – an individual confidential report on team progression and teammates' performance (submitted in week 5) and a collective report on teamwork progression (week 6) were analyzed by two researchers. This analysis focused on group perceived performance and group processes that team members implemented to organize their work. Group perceived performance was examined according to Hackman's (1987) criteria of team effectiveness. A sociometric test (Moreno, 1953, Mescon, 1959; Lucius and Kuhnert,

1997) was used to identify group structure and roles, revealing the density of each group[6]. This was measured by the number of ties that connect members with one another. These ties (either reciprocal or one-way) were identified according to students' answers to the question in the confidential report "Who do you prefer to work with"? A sociogram was developed for each group, displaying the number of interactions that occurred between members. Interactions in each group varied from very low (5) to high (19).

Step 2: Qualitative questionnaires on the 2011 tutoring experience and analysis of tutors' opinion in final juries.

16 debriefing questions were sent by mail to the 8 2011 tutors. 7 (2 female and 5 male) returned the questionnaire. Each tutor was in charge of 8 PBL groups. Questions (see Annex 1) addressed 4 issues regarding tutor's experience and perceptions: 1) observation of characteristics and progression of their groups, 2) explanation of their interventions as tutors and perception of their impact, 3) perception of roles and feelings as tutors, 4) perceptions and desires regarding available support for tutors. A qualitative synthesis of these perceptions was conducted by an independent researcher. At the same time, tutors' reports at the final jury were analyzed by the same researcher to explore the degree of precision of their qualitative observations on group dynamics in each of the groups tutored in step 1.

Step 3: Experimentation and interviews with 2012 tutors about a regulating tool based on sociometric tests.

In 2012, the same kind of project took place with the intake of first year students. 10 tutors were recruited to coach the 62 student teams. All tutors were PhD students in engineering domains: two of them had been tutors in 2011 in the same project, 4 were newly recruited tutors with tutor training, 2 were newly recruited tutors without tutor training and 2 came from a foreign institution and had never studied in a PBL curriculum.

To enable more rapid and efficient analysis of the confidential student reports (week 6), a computerized tool was designed to automatically draw the sociogram for each group. After the preliminary jury (week 7), all tutors had an exhaustive view of relationships in their groups. This was based on the anonymous sociogram and the group report. Drawing on results from Step 1 and Step 2, debriefing with the tutors were organized by the professor in charge of this PBL program after the preliminary jury. The aim of these meetings was: 1) to provide a tool (the sociometric test with anonymous typical examples) to help tutors be more precise about their observations of groups, 2) to build a regulating tool together (how could or should they intervene in such cases?). Then, considering the initial disappointing results of

[6] Mescon (1959) explains Moreno's sociometric method and applies it to leadership analysis. Sociometry is a "method of studying interpersonal relations in terms of attraction-repulsion patterns existing among group members. [ ] This sociometric technique maps these relationships quantitatively by having each member, for instance, list the persons in the group whom s/he likes most or least. By collecting these responses, it is possible to draw a structural map of the group in terms of the bonds holding the accepted members in and those tending to expel the rejected members" (p22). This technique has been used in educational settings to identify affinities between students (Vasquez & Oury (1971), Vayer & Roncin, 1987) but also in workplace settings to test the relationship between group density and satisfaction and perceived cohesion between members (Lucius & Kuhnnert, 1997). It is currently used in social network analysis (Lemieux & Ouimet, 2004)

those meetings (see results below), interviews were conducted by an independent pedagogical consultant with each tutor. These interviews attempted to gain richer information on tutors' perceptions of their observation and regulation role regarding leadership in groups and about the proposed tool based on the sociometric test. A preliminary synthesis of these interviews is proposed in step 3 below.

RESULTS

Step 1: 4 typical group configurations identified in the 2011 cohort

The analysis of collective and individual reports enabled the identification of four leadership configurations that emerged in the student teams (Verzat, O'Shea, Radu-Lefebvre, Raucent, Fayolle, Bouvy, 2012). The first category, "Waiting for Godot", (see a typical sociogram for this group in Figure 1a) comprised groups who did not succeed in organizing themselves in roles and task sharing and where no leadership strategy emerged. The working patterns adopted by groups in the second category may have initially created the illusion that some kind of leadership emerged but the potential generated by the "foot soldiers" petered out because of "hangers-on" who displayed a more passive attitude (see Figure 1b). The third category comprised groups (see Figure 1c), characterized by the emergence of "organizing leaders" who took command relatively late in the process to "save" the team and mobilize members to ensure a reasonable performance. The groups in the fourth category chose to distribute leadership roles among members, achieving a high level of satisfaction as regards their collective outcomes (Figure 1d).

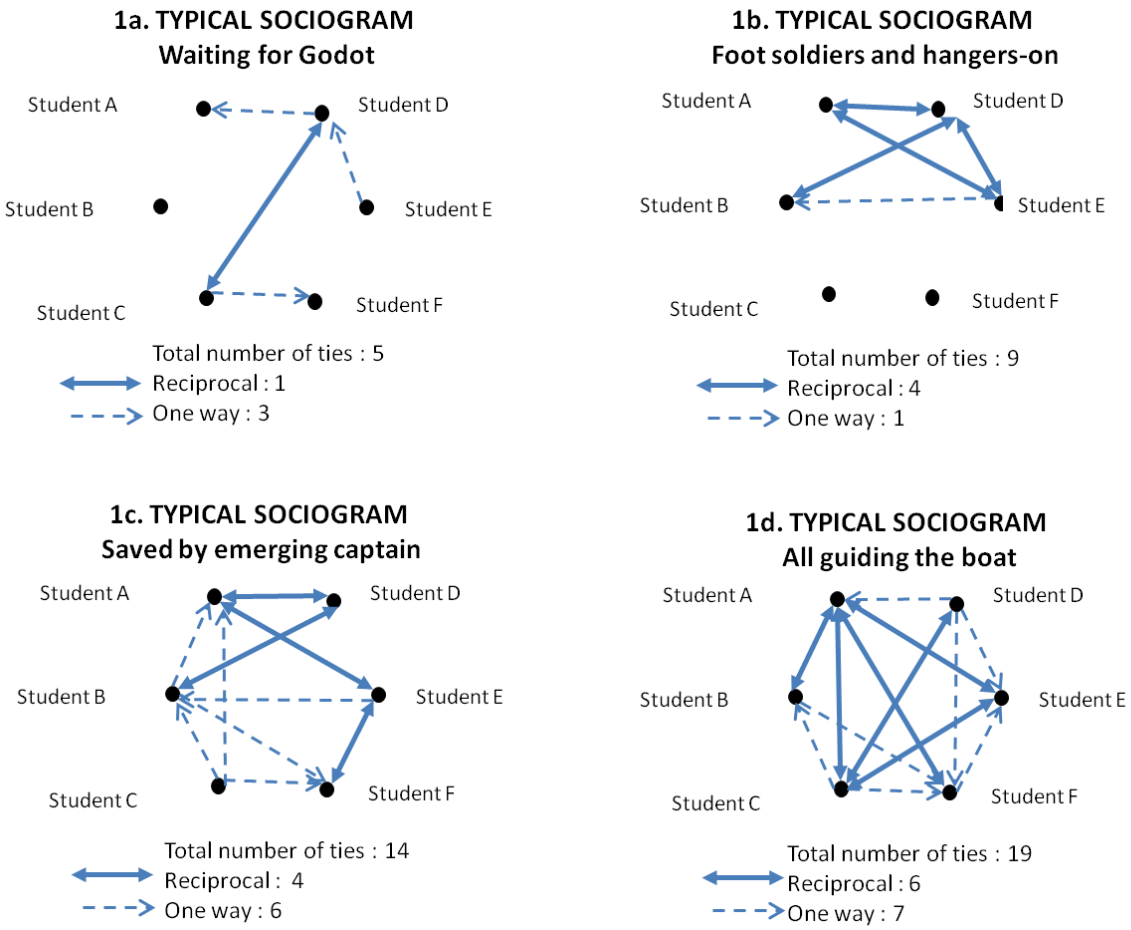


Figure 1 (a, b, c, d): Typical sociograms reflecting 4 leadership configurations

Step 2: Tutors' perceptions and behaviors with regard to the 2011 cohort

The analysis of the 7 questionnaires firstly reveals overall agreement with regard to tutors' perceptions of their roles as positively facilitating production outcomes in the student teams. Tutors generally perceive their roles as presented below ranked according to the number of times they were mentioned in the questionnaires:

- Expert (provide input on technical matters)
- Supervisor, timekeeper (make sure students respect rules and deadlines)
- Policeman (maintain law and order in groups)
- Guide, coach (structure work and progress; put them on the right track)
- Motivator (encourage them when they are floundering)
- Mediator (teach them to share knowledge and competencies)

They perceive this input as being useful, without which the students would not reach their objectives, and satisfaction is measured through linking the quality of their inputs with the groups' final outputs.

Secondly, there is a consensus on the nature of the difficulties they experienced which they consider prevented them from working efficiently. Role rotation is often considered artificial by tutors; they report that students are not convinced of its utility and they perceive a more

natural distribution of roles in terms of students' social and cognitive competencies. Despite these criticisms, some tutors observed that their groups perceived the utility of role rotation either too late, or when the workload increased, as this helped them plan and progress. Tutors often appear to be overwhelmed by the multiplicity of the roles they must play in what they consider to be a very limited timeframe. Some even plead for the presence of a second tutor to effectively observe group collaboration. Mirroring the negative feedback from students regarding the quantity of evaluation reports required, tutors commented on their generally botched nature, estimating that they were of little value.

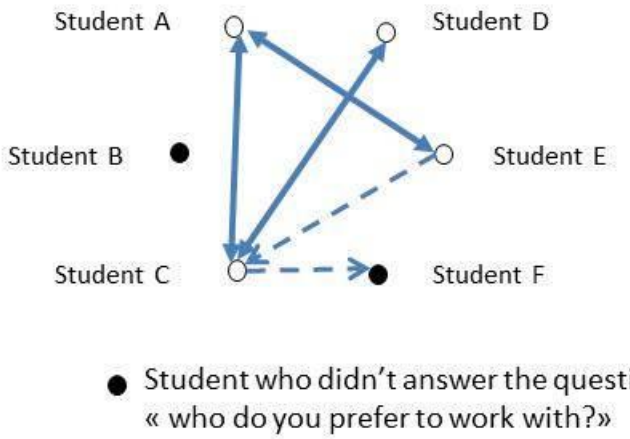
Thirdly, however, there is less agreement with regard to the role of the tutors in regulating problematic teamwork behaviors. This is reflected in the fact that some tutors apparently never encountered problems that required regulation; others seemed a little helpless when faced with students who did not pull their weight and 2 tutors called on the project supervisor to regulate conflicts that had arisen in their groups. Some tutors also expressed discomfort with the students' confidential reports, particularly as regards the question "who do you prefer to work with", judging this to encourage a denunciatory type of behavior and even questioning the ethics of such a document.

Despite the difficulties presented above, the tutors expressed satisfaction with what they considered to be the constructive behaviors of students which enabled them to focus on their work. This is corroborated to a certain extent by an analysis of the final marks obtained by a cross-section (24 groups) of the 4 leadership categories identified in the 2011 cohort. The marks varied from 11 to 17 on 20 with an average of 14 for categories 1 and 3 and 14,5 for categories 2 and 4. The highest marks (16 and 17) were attained by 2 groups in categories 3 and 4 respectively, with the lowest (11 and 12) in groups 3 and 1 respectively. However, further analysis of each tutor's marks and commentaries in relation to group performance within the different leadership configurations is still required.

Step 3: 2012 tutors' reactions to the regulation tool based on sociometric tests

In week 7, during a tutors' coordination meeting, the 10 tutors were invited to react in groups to the presentation of 12 typical anonymous examples drawn from the 62 groups analyzed. Immediate reactions were rather ambivalent. Firstly, tutors expressed uneasiness and mistrust of the test. The general feeling was that the question "who do you prefer to work with?" was too narrow: "The question does not enable them to express the degree of preference", "It would have been interesting to have asked the reverse question", … On the other hand, the different anonymous examples provoked immediate recognition of situations where they were confronted with real problems.

Figure 2a
Godot example in 2012



A striking example (see figure 2.a) is an anonymous example of the Godot category where the sociometric test reveals that some students did not want to answer the question "who do you prefer to work with ?" and where the other students did not choose them either. Immediately tutors recognized that "There are real problems with certain students in some groups because nobody wants to work with them".

Figure 2b
Hanger-on in 2012

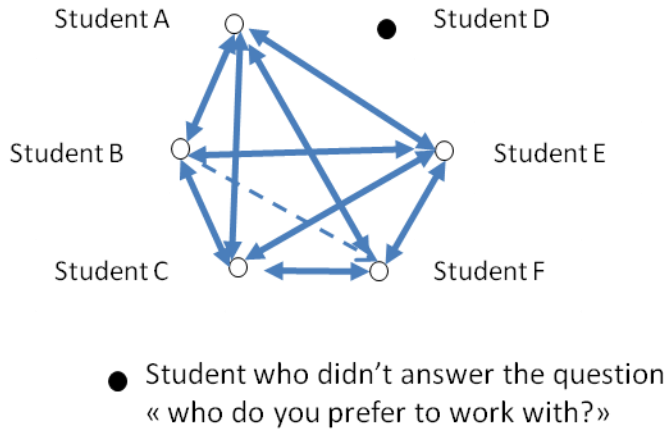


Figure 2.b, shows another example of a situation where the sociogram identifies the non-participation of one student in a particular group. The problem was reported to the tutor by a concerned student in the group and this enabled him to confirm his intuitions about problematic group interaction during an exchange with the project supervisor. However, the tutor did not appear to be able or willing to regulate this issue by himself.

When tutors were invited to go a little further in the discussion about what they could propose so as to react to such situations, they expressed the same embarrassed position. On the one hand they recognized that there were interpersonal problems within groups that should be dealt with. But on the other, they tended to refuse proposing their own solutions. As a result, it was impossible to obtain their collaboration in completing the tool with suggestions for regulation practices or to have any authentic discussion in the tutor group on this topic. However, some tutors subsequently started private discussions with the professor in charge of the project (first by email, then orally).

Interviews with tutors carried out by an independent consultant went deeper into their perception of this tool, and attempted to pinpoint perceptions about what really happened in groups to highlight their roles in group dynamics regulation. A preliminary synthesis of these interviews extends our comprehension on this matter.

Firstly, the tutors generally believe that they are responsible for the effective functioning of the groups. They are particularly at ease when it comes to facilitating group production, not hesitating to orchestrate students' activities. Because they are focused on production outcomes, they can easily identify and challenge students who do not pull their weight. However, they are much more uncomfortable when it comes to regulating the social dynamics manifested in the groups. They recognize that motivation is essential but they find it difficult to understand how it operates from one group to another. They have a tendency to allow the groups to organize themselves because they are unsure about how to facilitate role rotation and even question the utility of imposing roles such as that of moderator. They do not consider that their role is to influence the group climate, leaving this up to the students, nor do they intervene to regulate interpersonal difficulties experienced in the groups.

Secondly, findings also demonstrate differences in the attitudes the tutors have concerning their role. Those who are focused on production outcomes tend to manifest a more directive style, challenging the students to work, reminding them of rules and deadlines, including those who appear to be lagging behind. Those who are interested in motivating students tend to play the role of facilitator, putting the onus on students to take on responsibility for group outputs.

Finally, the sociometric tests reveal group interactions with which tutors are not very familiar and which they have difficulties in mastering, such as why some students are excluded or some work well together. While this may explain their reticence in using the regulating tool proposed, it is interesting to note that at least some of the tutors recognized its utility in dealing with extreme cases or with groups that function badly.

DISCUSSION AND CONCLUSION

If we sum up findings from steps 2 and 3, tutors seem to accept and enjoy their role as facilitators in PBL student groups. Their official discourse shows that they are aware of taking on different attitudes and roles which relate to the needs expressed by groups at particular times and in various situations. These attitudes and roles are reflected in the three coaching postures as applied to students, described by Verzat, Raucent and Villeneuve, (2010) following Paul's model of 3 coaching professional postures inherited from the Greek culture (Paul, 2004) : expertise-driven, action-oriented and hermeneutical.

Our findings suggest that PBL tutors that come from engineering backgrounds, and who have experienced PBL themselves, are more comfortable with the production oriented posture, than with the social regulation of groups. This is in line with previous research on tutors' limited capacity to assess and guide social group dynamics (Tipping, Freeman and Rachlis, 1995, Raucent et al., 2009, Stojcevski and Du, 2009, Hoolgard and Kolmos, 2009). We also found that tutors have different styles and attitudes, some more authoritarian and others more facilitating, which may contribute to different configurations in student-tutor relationships (Faidley et al, 2000).

Results from Step 1 showed that the sociometric test is a useful tool for assessing leadership configurations leading to performance, learning and satisfaction in student groups. Steps 2 and 3 tested the sociogram as a pedagogical tool that should enable tutors to describe and regulate the social dynamics of student groups under their charge. Our results show that the sociogram is a useful tool for observing the ways group function and how leadership manifests itself, corroborated by the higher marks attained by groups in categories 3 and 4 in 2011. However, we also found that tutors are not comfortable with a tool that highlights ambivalent zones in which ownership for regulating remains fuzzy. While it seems legitimate for tutors to focus on production and deadlines in groups where no leader emerges, helping to solve intepersonal conflicts or to foster implication, motivation or socio-emotional quality in groups seems to be left up to the students. As this in itself is a major source of dissatisfaction among them, clarity about who should regulate here would alleviate these difficulties.

Even if the test reveals uncomfortable situations for the tutors, the sociogram proves very useful in critical cases. The researcher who collected and analysed the data in step 3 reported that tutors came to the interviews armed with the sociometric drawings of their difficult groups and became more open about trying to find solutions. Individual (rather than group) meetings between tutor and teacher on ways of using the tool appear to be effective, given that tutors are looking for personalised advice to give to problematic groups. Further research is required to devise a solid methodology in using the sociogram for regulating interpersonal issues in PBL student teams.

Annexes

Annexe 1 : Qualitative questionnaires on 2011 tutoring experience.

1. How did your different groups manage ?
2. Did you encounter specific difficulties with one of the groups you were tutoring ? Which group and which difficulties ?
3. What are common features of all groups ?
4. What characterizes each group ? (for example, group progression, group dynamics in terms of roles and leadership...)
5. How do you perceive each group evolution ?
6. When did you have to intervene (systematically, at certain steps, because of certain observations or perceptions, why, can you illustrate with a situation ?)
7. Did your intervention have an impact on group dynamic ?
8. Generally, how do you perceive your role as a tutor ?
9. Why is this role necessary ? What does it useful for ?
10. How is this role perceived by students ?
11. What is easy or difficult to assume (illustrate with precise situations)
12. What are your main satisfaction or deceptions ?
13. What kind of support do you get to help as a tutor ? is it efficient ? necessary ... ?
14. What is missing in the training/preparation/ support you get as a tutor ?
15. ideally what could be useful for you to help you as a tutor ? (for example, training on a particular subject, support or dialogue with somebody, tool...)
16. Other comments you would like to add...

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What teacher education students learn about collaboration from problem-based learning

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ABSTRACT

Group work, an essential component of learning and teaching in problem-based learning (PBL), is compromised if students' experiences of PBL are colored by dissatisfaction with the process or outcomes. For the potential benefits of PBL to be realized PBL group work must be genuinely collaborative to address students' personal and professional learning needs. Australian teacher education students (n=122) provided written reflections on PBL that enabled representations of their group work experience to be mapped using an Attitude, Skills, and Knowledge (ASK) framework to gauge understanding of the collaborative learning process (as learners and as future teachers). Attitudes identified as necessary for collaborative learning were valuing others' perspectives, interdependence, and learning about self. The Skills dimension characterized interpersonal, problem solving and group skills. Features of the Knowledge dimension were: generation, application, and dissemination of knowledge. Pedagogical knowledge was also evident through learning connections made by students to their future teaching practice.

Keywords: Problem Based Learning; Teacher Education; Collaborative Learning

INTRODUCTION

The defining features of problem-based learning (PBL) are: that professional 'real-world' problems provide the stimulus for student-driven learning that occurs in small groups; that it is effectively facilitated, not directed, by tutors; and, that it focuses on building content knowledge in tandem with developing problem-solving, self-directed learning, and

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collaborative, teamwork, skills (Barrows, 1996). Collaborative learning principles underpin the way PBL works, and collaboration within the group work structure of a PBL tutorial is prerequisite for the benefits of PBL as an approach to learning to be realized.

In terms of learning theory, there is a strong support base for incorporating collaborative group work as part of a student's learning experience. (2005) Social constructivist principles drawn from Vygotsky's (1976) notion of learning as a process of negotiating meaning, facilitated through language and interaction with others (Loftus & Higgs, 2005) sit comfortably with the more traditional cognitivist frameworks that underpin much contemporary (psychological constructivist) learning theory (see Bruning, Schraw & Norby, 2011). As well, social constructivist principles reinforce the idea that collaborative learning provides the opportunity for students to acquire both conceptual and procedural knowledge by using course content to grapple with problems they are likely to encounter in their future professional practice (Michaelsen & Sweet, 2008).

This paper contributes an in-depth examination of collaborative learning in the PBL tutorial because even though group work is an essential component of learning and teaching in PBL, tutors and students continue to experience difficulties related to working with and in groups, highlighted in previous research where students' negative perceptions of PBL have been shown to be largely colored by dissatisfaction with group work (Holen, 2000; Peterson, 1997; Pfaff & Huddleston, 2003). In this paper, we argue that setting up a group to be collaborative requires attention be given to process-related as well as content-related PBL outcomes because learning collaboratively depends on a set of group work specific attitudes, skills, and knowledge that students either bring to or develop within the group. An Attitude, Skills, and Knowledge (ASK) framework, developed by the authors (see Pourshafie & Murray-Harvey, 2013) is used to synthesize the dimensions of collaborative learning identified by teacher education students in the context of their problem-based learning as well as to examine the extent to which working collaboratively enhanced the learning experience. The ASK framework is extrapolated from theoretical models of the learning process such as the Model of Strategic Learning (see Weinstein, Jung, & Acee, 2010) that presents knowledge, skills, will, and self-regulation as critical, interacting components of strategic, self-regulated learning. Knowledge, skills and attitudes are terms generally referred to in the literature (e.g. Baartman & de Bruijn, 2011) as the elements that define professional competence (see also Lizzio & Wilson, 2004) and much of the PBL literature uses these terms in discussion around the purposes and practice of PBL. In this paper Attitudes indicate the dispositions and/or predispositions of students towards group work; Skills are the capabilities that students need for effective collaboration; and Knowledge refers to the essential concepts and principles needed to engage collaboratively, and for teacher education students includes pedagogical knowledge.

More than 10 years ago Holen (2000) claimed that while attention had been given to a range of issues related to achieving PBL objectives, "less attention seems devoted to the dynamics of the interaction within PBL groups." (p. 485) Since then, group processes have captured the attention of researchers who have investigated either in combination or separately, the knowledge, attitude and skill dimensions of group learning in PBL (see Mamede, Schmidt & Norman, 2006; Svinicki, 2007, for comprehensive overviews). Yet, despite the voluminous amount of research conducted on PBL in medical education including product (e.g. content knowledge) as well as process (e.g. problem-solving) outcomes, Schmidt, Rotgans and Yew (2011) a decade later, express the view that "the tutorial group, vital to the inner workings of PBL, remains in many respects a black box" (p. 802). Discussions around collaborative learning regularly appear in the business education and organizational learning literature indicating points of concern not dissimilar to those raised in the health sciences and education, where interest in collaborative learning is connected to preparing professionals who can work effectively with others (Hansen, 2006).

Collaboration – a graduate attribute

Early on in the adoption of PBL, the idea of PBL to be structured around group study included the argument that through collaborative teamwork PBL developed skills necessary for professional practice (Barrows & Tamblyn, 1980). Teamwork and collaboration continue to be regarded as important graduate qualities/attributes (Murray-Harvey, Curtis, Cattley, & Slee, 2005; Riebe, Roepen, Santarelli & Marchioro, 2010; Treleavan & Voola, 2008). Of the 39 universities across Australia, 22 universities list effective teamwork and/or collaboration skills as desired graduate attributes (The National Graduate Attributes Project, 2008). The stress on teamwork is mirrored in the international generic skills literature as well, exemplified in the Forfás (2007) review of trends in the United Kingdom, Ireland and the USA indicating a "…rise in the importance of generic skills, including the ability of individuals to work more autonomously; be self-managing, work as part of flexible teams, adapt to change, solve complex problems, think creatively and engage with innovation as a continuous process." (p. 3)

Collaborative learning - more than group work

Peterson (2004) identifies teamwork as one of three critical factors for successful PBL stating: "An ill-structured, authentic, and relevant problem is just the catalyst to make individuals come together. However, it takes more than just a good problem to make a group of people function as a team" (p. 640). Summers and Volet (2010) also argue that while working in a group on a common task may be a prerequisite for collaborative learning to occur "group work does not necessarily entail students learning collaboratively" (p. 474). These points concatenate with claims made elsewhere in the literature (e.g. Hansen, 2006; Page & Donelan, 2003) that problems with group work in PBL tutorials are likely to arise from the misconception that collaborative teamwork is an assumed outcome of merely placing students into groups.

Summers and Volet (2010) proposed that students need to engage in learning through co-regulation and co-construction of knowledge with other members of the group in order to realize the learning benefits (i.e. deeper understanding and retention) ascribed to collaborative learning. They identified key descriptors of co-regulation as negotiability, interactivity and dialogic interactions and characterized co-construction as high level cognitive-metacognitive processing, such as transformation of information through, for example, elaborations, explanations, and critical reflection on the content of the task (p. 474). In other words, collaborative learning involves more than distributing and reporting information.

Teamwork - more than group work

Michaelsen and Sweet (2008, p. 4) identify four prerequisites for successful group work: Groups must be properly formed and managed; students must be accountable for the quality of their individual and group work; students must receive frequent and timely feedback; and, group assignments must promote both learning and team development. In addition, students need prompts to explicitly think about group processes. Students need to know about the purpose of group work. These authors contend that few students have knowledge either about how groups work or the empirical evidence for the superior outcomes that collaborative learning offers when tackling complex tasks.

Emphasis on group work is not without its critics. Eva (2002) cited that research has not provided evidence that teamwork results in better success on learning outcomes than individual study, or that interdisciplinary teams regard teamwork more positively than others. Contrary to this, Schmidt, Rotgans and Yew (2011) in their review of the PBL process provide extensive research evidence that small group discussion, compared with individual problem analysis, not only stimulates the use of elaboration strategies, but also adds to longer-term knowledge retention. In addition to knowledge gains (the focus of cognitive constructivist researchers), Schmidt et al. (2011) also refer to the social and affective benefits of using group work to build communities of learners.

Collaborative learning in teacher education PBL

Newman (2005) highlighted that "it is not always clear what exactly is being done in the name of PBL" (p. 12) and used Bereiter and Scardamalia's (2000) notions of PBL (upper-case) and pbl (lower-case) to distinguish between PBL that aligns with "the structures and procedures first systematized by Howard Barrows" and pbl that is representative of "an infinite range of educational approaches that give problems a central place in the learning activity" (p. 12). The students who engaged in PBL in the study reported in this paper experienced upper-case PBL, following the 7-step Maastricht model (see Wood, 2003) albeit in a hybrid form since the PBL case studies, while interdisciplinary in conception and implementation were confined to one course that extended over one semester, and was delivered concurrently with lectures.

While students across all professions need to know that capability to work in a team environment is a workplace expectation, teacher education students also need pedagogical knowledge - to know how to form groups, how to design and implement team building activities, and how to create classroom environments that support collaboration (e.g. respect, trust, empathy). In a meta-learning sense, teacher education students need to connect their own learning about working in a group with their future teaching roles. In the context of the PBL tutorial the tutor is well positioned to model concepts related to this set of knowledge, skills and attitudes in the way they form groups and create a collaborative classroom ethos, to scaffold the development of collaborative learning skills by providing practice opportunities and explicit feedback on group performance, and to expect desired knowledge, skills and attitudes to be demonstrated through the assessment tasks.

Attitude, Skill and Knowledge dimensions of collaborative learning

Barrows and Kelson (1993) identified the development of attitudes and skills necessary for effective teamwork as a key educational objective of PBL asserting:

> The PBL Process is designed to encourage development of the skills necessary to work and learn effectively as members of a collaborative team working toward a common goal without sacrificing the development of the individual as a competent, confident, independent contributor to society (p. 3).

Among the attitudes, skills, and knowledge that PBL is said to develop, Newman (2005) lists 23 capabilities, of which six are related to the learning about effective group work that occurs through the group work process itself: collaborating productively in groups or teams, active listening, interpersonal skills, group and chairperson skills, coping creatively with conflict, and practicing empathy/ appreciating another person's point of view.

In order to capture teacher education students' perspectives on their PBL collaborative group work experience, and to better understand the potential of collaboration to optimize learning opportunities for students, two research questions guided the study reported in this paper: (1) what attitudes, skills, and knowledge about group work do teacher education students regard as important for teaching and learning? And, (2) to what extent was collaborative learning a feature of students' group work experience?

METHOD

Context of the study

For 10 years PBL was offered as an optional stream in one compulsory course 'Development Learning and Inclusive Teaching (DLiT)' where both undergraduate and postgraduate Bachelor of Education students together studied two cases over a 1-semester period. In 2009 a

Master of Teaching degree was introduced and postgraduate students with no teacher education background enrolled in the equivalent course but attended separate tutorial groups. All students attended the same lecture series, worked on the same PBL case studies, and undertook the same assessment tasks.

The PBL case studies

The two written cases that students studied followed the 7-step problem solving procedure for PBL cases used at the University of Limburg, Maastricht (after Gijselaers, 1995) where the 'story' of a case is disclosed to students progressively over a series of tutorials (see Wood 2003 for a concise summary of the process); in this course each case was conducted over three consecutive 2-hour tutorial sessions. The cases were developed in consultation with practicing teachers and designed to ensure (1) that students would cover the course objectives and content; (2) that the cases represented teacher problems not student deficits; and (3) authenticity – that the problems represented relevant and meaningful classroom issues. The case studies in this course were embedded within a program that included, along with the 2-hour PBL tutorial, a series of lectures, set readings and class activities related to the educational and developmental psychology content objectives of the course.

Preparation for collaborative learning involved providing students with preparatory reading and lecture input on related research, and included discussion in class about that reading, their previous positive and negative experiences of group work, and, based on the professional educational literature, in-class modeling and practice in forming and facilitating groups to be effective teams (Oakley et al., 2004). This preparation occurred prior to the PBL case study. A further departure from the way PBL works in other fields of professional study is that students were required to pay attention to the process of PBL teaching and learning as part of the assessment requirements of the course, to critique their PBL experience and to reflect on the positive and negative elements of this approach to teaching and learning. PBL tutors were all teachers with considerable school classroom experience and expertise as facilitators.

The PBL tutorial worked with classes varying between 15-25 students, grouped into teams of around five students per group. At the end of the third tutorial a fourth week of non-contact was given to allow time for groups to prepare an overview of their group's solution to the case problem to present to their peers in the following (fifth week). The tutorial process is summarized in Table 1.

Table 1: Overview of the Structural, Process and Content Elements of the Problem-based Learning Tutorials

PBL structure	**7-step Process**	**Content**
Tutorial 1 1-hour whole class student-directed tutorial followed by 1-hour meeting time scheduled for small group work.	Whole class works together on the problem (Steps 1-4: Clarify, Define, Analyze, Review); Small groups begin to formulate how they intend to work through the learning issues (Step 5: Establish learning goals)	The case unfolds step-wise through presentation of 'pages' of information following a 'trigger' scenario. A page of suggested references and resources is provided as a basis for inquiry.
Self-directed study	Students choose the ways they want to tackle the tasks they have set (Step 6: Self-study)	Students are encouraged to explore other potential sources of information.
Tutorial 2 (one week later) 1-hour reconvene and review 1-hour whole class tutorial and small group work	Small groups reconvene to discuss learning; Significant learning of groups shared with whole class (Step 7: Report and synthesize) Whole class proceeds with the case. Small groups re-form to continue work.	Further 'pages' of information are presented.
Self-directed study	Students choose the ways they want to tackle the tasks they have set	Students are encouraged to explore other potential sources of information.
Tutorial 3	Small groups reconvene to discuss learning. Significant learning of groups is shared with whole class Whole class proceeds with the case.	At the end of the tutorial students receive instruction on the focus of the group presentation task.
Non class contact	Preparation for presentations.	
Group presentations	15-minute Presentation of problem solution(s) + time for peers (anonymously) and tutor to write feedback.	Peer and tutor evaluations are recorded on prepared feedback forms and provided to the presenting group
Post presentation debrief	Each group records its own evaluation on one feedback form ready to discuss with tutor in light of peer and self evaluations Students complete self-assessment of tutorial performance and discuss responses first with group members and later in meeting with tutor	Small groups meet together Groups meet with tutor *Tutorial performance survey* (using a 4-point rating scale) assesses competence across four dimensions: Knowledge, Problem solving; Presentation skills; Personal/interpersonal communication skills

Course assessment

Three assessment tasks contributed to the overall grade for the course: (1) a 1000 word report that asked students: '*From your understanding of the PBL literature and your own experience, justify why you would or would not use PBL as a classroom teacher'* submitted mid-term after the first case and assessed by tutors (20%); (2) an oral presentation of each group's 'solution' to the case problem delivered to peers and tutors at the end of the semester and assessed by peers and tutors (30%); and (3) a 2000 word end of semester Learning

Evaluation submitted after the group presentation that instructed students to '*Critically reflect on your learning … to answer the question: How does your understanding of development, learning and inclusive teaching establish the foundations for you to become an effective teacher?'* (50%) This final paper required students to draw on reflections on learning and teaching made over the semester in their Professional Journal and to submit these with their Learning Evaluation paper. The journal entries for final two weeks specifically asked for reflections on group work skill development (penultimate journal entry) and their PBL experience (final journal entry).

Participants

Students who consented to researchers using their assignments for analysis provided background information on sex, age, and previous learning using PBL. Of the 122 students for whom data were available the proportion of males and females (36% males) was representative of the student cohort. The spread of participants was as follows: 74 were undergraduate, representing 40% of students enrolled in an undergraduate PBL class, and 48 were postgraduate, representing 70% of the postgraduate student group. Students' ages ranged from 19 to 52 years (Mean age 24.5 years; SD 6.81) with an average difference of 10 years between undergraduate and postgraduate students. Six students reported having been involved with PBL before.

Sources of data

The PBL report (Assignment 1), the Learning Evaluation (Assignment 2), and the final journal entry that sought *'reflections on experiences about learning and teaching using PBL'* were the written sources of data drawn on for qualitative analysis. The high demand made on students to reflect on their PBL learning experience progressively over the semester gave researchers confidence that final papers would elicit reasonably well-considered comments on PBL taking into account initial reactions to learning through PBL earlier in the semester, reading and writing about PBL, and having been engaged in learning through PBL for a full semester. Journal entries of 67 students (55% of participants), Assignment 1 reports submitted to researchers by 58 students (approximately 48% of participants) and Learning Evaluations of 46 students (approximately 38% of participants) that referred to PBL enabled these documents to be used for analysis.

Analysis

All three sources of data were entered into NVivo software (2008) and first coded using line-by-line or open coding (Strauss & Corbin, 2008) looking for words and phrases indicative of students' engagement either in group work or collaborative learning. Postgraduate students' data were coded separately from undergraduate students' data anticipating that there would be differences in the levels of collaborative learning engagement between the two groups. The first coding analysis focused on features of students' group work experiences. Further analysis looked for evidence or indications of students' engagement in collaborative learning.

The researchers worked together to determine the categorization within each of the ASK dimensions.

To assist with deeper analysis of the students' collaborative learning experiences, data were coded again looking for any evidence of co-regulation and co-construction. Evidence of shared interactions, negotiation and learning more by working with others were coded under co-regulation. In the same manner, any indication of students engaging in high level cognitive, meta-cognitive activity, deeper or higher level thinking, critical thinking, meta-learning and reflection were coded under co-construction. Coded data were then categorized in a matrix separating the co-regulation and co-construction responses between the postgraduate and undergraduate students.

In summary, students' texts provided a rich source of data on the extent to which collaborative learning was a feature of students' group work experience, and the meaning they attached to effective group/collaborative work for their learning and future teaching.

Results

References made to key elements of collaborative learning extracted from the PBL literature were amenable to classification as Attitude, Skill, or Knowledge. The ASK framework dimensions were then used to classify students' statements about group work/collaborative learning. Following this first classification further analysis revealed sub-categories within each of the dimensions. Table 2 provides a summary of indicative statements representing the three dimensions of Attitudes, Skills, and Knowledge, and the sub-categories. Notwithstanding the distinctiveness of the three dimensions there was some (inevitable) overlap, discussed later in the paper.

Table 2: Summary of Indicative Statements Made by Students on Attitudes, Skills and Knowledge for Effective Collaboration

Dimensions	Categories	Indicative statement(s)
Attitude (towards group work)		
	Valuing others' perspectives	• Openness to other people's point of view • Allowing contrasting opinions and perspectives • Can learn from others • Show humility in order to achieve the common goal
	Interdependence	• A sense of belonging/a place of learning for all • Taking ownership and feeling included • Enjoyable and conducive to developing new relationships/friendships • Trusting other group members • When people work together stronger outcomes can be achieved
	Learning about self	• Learning to recognize and show positive personal attributes • Noticing significant changes in behavior and perception e.g. confidence; self-esteem • Learning from each other and contributing to the whole group • Valuing achievements of the group over personal achievements
Skills (for group work)		
	Interpersonal (social)	• Capability to work within a team based environment • Sharing and communicating positively • Know how to act in social situations and get along with different people
	Problem solving	• Work as a group towards finding solutions to problems • Think critically to solve problems • Use higher order thinking strategies • Ability to hypothesize
	Group	• Sharing out roles and responsibilities • Group dynamics i.e. how groups work • Conflict resolution e.g. dealing with dominating members
Knowledge about (the purpose and principles of) group work		
	Generation	• Teacher not the main source of information but one who facilitates knowledge generation • Activates students' prior knowledge • Refines and sorts knowledge • Experience deeper level of learning • Investigate different ideas and concepts • Encourages participation and motivation to succeed
	Application	• Take responsibility of own and classmates' learning • Connect theory with real life • Build self-efficacy • Relevance to future work e.g. collaboration between other teachers, faculty members and parents to meet students' needs
	Dissemination	• Group members share previous knowledge and researched ideas

	• Group work as a forum to rationalize and clarify ideas • Encourages dialogue, questioning, initiative, creativity and reflection
Pedagogical	*Declarative knowledge* • Focus on the process over the outcome • Emphasis on students learning to become self-reliant and eventually independent • Teachers must understand the various dynamics that occur within classrooms • Builds skills and relationships vital to students' social, emotional and cognitive development outside the classroom *Procedural knowledge* • Effective practices need to be taught and nurtured e.g. explicit teaching of how to work well in a group • Select groups to accommodate diversity (race, gender, interests, abilities, disabilities, learning needs) to create an inclusive classroom • Assign roles to group members • Arrange classroom e.g. tables in groups - to facilitate group discussion • Teacher provides resources, guidance and support required for students to succeed

Although some differences were noted between undergraduate and postgraduate students' reflections they were not distinctive enough to warrant separating the presentation of results by group. Student quotes are provided with the text identifier to indicate the whether the text source was from a journal reflection (JR), the first written assignment (A1) or the final, learning evaluation (A2) and an identifier to indicate whether the student was an undergraduate (UG) or postgraduate (PG). Most excerpts quoted are from texts of different students. The results are reported in two sections, to address each research question.

What attitudes, skills, and knowledge about group work do teacher education students regard as important for teaching and learning?

Attitude

From students' statements about their group work experience three distinct sub-categories of Attitude were identified that have been labeled as 'Valuing others' perspectives', 'Interdependence' and 'Learning about self'.

Valuing others perspectives

Students considered group work more effective than working individually as not only 'students can feel valued' (A1, UG female) but also can 'see other people's perspectives' (A1, UG female). A student commented 'The group experience has been great and really opened my eyes to other people's point (sic) of view' (A1, UG female). Commenting on his observation of group work during teaching practice, one student stated that 'Small groups were successful only if all members had their voices heard' (A1, PG male) whilst another

affirmed that 'working collaboratively is very different than spending time socially' (A1, PG female).

Students' reflections manifested understanding of the value of a humble posture of learning. A student commented:

> It was a key outcome from our group...to understand in more genuine and practical ways that whilst individual differences and skills are important to add breadth to expertise and group outcomes, true collaboration has the potential to add so much more value to not only the project outcomes, but also to the personal and professional learning of individuals within the working group' (A2, PG female).

Interdependence

Undergraduate and postgraduate students alike recognized that 'group work is a vital part of student development and critical in social conditioning' (A1, UG female). Collaborative group work created a space 'to know people' (A1, UG female) and 'to come to satisfying conclusions as a group...' (A1, UG female). Working together was acknowledged as necessary 'to work out the objectives of the task and successfully complete it' (A1, UG male), thereby having an impact 'on academic and interpersonal outcomes' (A2, UG female). Students identified collaborative group work as enjoyable and conducive to developing 'new friendships' and through a sense of obligation to the group, taking 'ownership of their roles' (A2, UG male) within the group. Students felt that group work created a sense of belonging making it 'a place of learning for all students' (A2, PG male). They reflected that collaborative work enhances learning through 'social interaction, the power of purpose and is highly effective when student centred' (JR, PG female). Postgraduate students in particular articulated a deep understanding of the need for interdependence and an awareness of the need 'to rely on other group members to undertake their own self-directed learning to fill in your knowledge gaps' (JR, PG female).

Learning about self

Students 'found it surprising to realize that when all students interacted and bounced ideas off each other it was a very efficient way of completing the task at hand' (A1, UG male). They also noted personal attributes that contributed positively to their group reaching a common goal, for example, group work 'has taught me to value the achievements of the group over personal achievement. (JR, PG male). Another student 'noticed significant changes in [her] behaviours and perceptions to group work, that were both enlightening and empowering' and felt that 'even the more mature CAN change their views and behaviours and improve practice' (A2, PG female). Students developed awareness of themselves as learners and from each other. One student reflected that she was able to maintain 'cohesiveness through encouragement and positive affirmation', and for her future students 'I learnt that the student needs to be acknowledged as a whole person…' (A2, PG female).

Skills

The three discrete sub-categories that emerged from examination of students' statements about Skills were: 'Interpersonal (social) skills', 'Problem solving skills' and 'Group skills'.

Interpersonal (Social) skills

Students stated that through group work they were able 'to develop socialization and collaborative skills' and were enabled 'to work within a team-based environment', enhancing their skills through 'collaborative and cohesive structures of learning' (A1, UG female). One student commented that 'The active involvement within groups develops the social skills necessary for cooperation and teamwork' (A1, UG female). Students articulated the importance of using group work in their own classes as it helps to develop 'skills and relationships' essential to their 'social, emotional and cognitive development outside of the classroom' (A2, UG female). Students believed that 'collaborative group work' was an effective way to 'learn how to act in social situations and to learn to get along with different people' (A2, UG female).

Students were aware of the valuable 'communication skills and interpersonal intelligence' (A1, PG male) and 'professional and team working skills' learnt during collaborative group work which equip students 'for life beyond university' (A1, PG male).

Problem solving skills

Students considered that 'to collaborate and work as a group through the problem' (A2, UG female), enhanced their 'problem solving skills' (A2, UG female). They felt students at every level needed to be equipped with problem solving and collaborative skills (JR, PG female). Others reflected on their positive experience of working 'collaboratively towards finding solutions to problems' (JR, UG female) noting that in order 'to solve or help to solve the PBL case' they were engaged in deep critical thought about learning and teaching (JR, UG female).

Group skills

We identified three types of group skills that students regarded as necessary for working effectively with others in PBL and for fostering a positive learning environment as future teachers. Students referred to the need to be skilled in sharing roles and responsibilities, for example 'Through working in our own groups many different skills were developed further such as communication, delegation, researching, presentation just to name a few' (JR, PG male). They also recognized the importance of being able to skillfully manage group dynamics, as described by a student who reflected that 'I will need to understand myself the dynamics of group work and how they function so that I can facilitate and oversee success' (A2, UG female). The need for conflict resolution skills was suggested in statements like 'teachers must support their students on a variety of levels, including promoting effective group interaction' (JR, PG female), 'my group was not a well functioning group despite trying

myself. It has left me with many questions on how to handle 'difficult' people' (JR, PG female), and 'the students' 'relational and cooperative skills' grew and they displayed 'inclusive behaviour' and were able to deal with 'conflict' (A1, UG female).

Knowledge

The Knowledge dimension represents ways in which students considered that their subject matter learning was enhanced through collaborative endeavor. Three sub-categories of Knowledge statements were identified: Generation of knowledge, Application of knowledge, and Dissemination (diffusion and sharing) of knowledge. A further Pedagogical knowledge category was created to represent knowledge about how collaborative learning might be used as an instructional approach.

Generation of knowledge

The process of group work 'using piece by piece information, discussion, previous knowledge and experience, brain storming and further independent investigation' (A1, UG female) generated knowledge to be able to solve the problem. Students' active involvement in the generation of knowledge in the PBL tutorial brought with it a realization of 'the importance of collaboration work in the classroom' which meant that 'no longer is the teacher the main source of information but facilitates and asks many open ended questions' (A2, UG female). In generating knowledge, collaborative group work helped to activate students' prior knowledge and allow 'refining and sorting' (A2, PG female) of knowledge. Their search for pieces of information allowed group members to 'experience a deeper level of learning' (A1, PG female). The investigation of 'different ideas and concepts both autonomously and within a group' (A1, PG female) led to a number of students commenting on retention of greater amounts of knowledge.

Application of knowledge

Collaborative group work led to students' knowledge and ability to 'coordinate effective student learning' (A2, UG female) and to take 'responsibility for their work' (A2, UG female). Students felt that the discussion of the case using their collective information not only developed social skills, but also highlighted the need 'to take responsibility for their own learning, as well as their classmates' (A1, PG male). One student remarked that 'the shared discussions, stories and experiences extended my knowledge of people's teaching contexts and helped me to connect the dense theory of my course with real life' (JR, PG female) and another commented 'Group work helped me to make concrete many of the strategies I had brought to the group, improving my own self-efficacy' (JR, PG female).

Dissemination (sharing) of knowledge

Students' interaction with each other during collaborative group work created a space to share their knowledge. As one student observed 'group members started scaffolding the learning process by bringing to the table what they already knew as well as ideas they had researched'

(A1, PG female) thus providing a 'forum to rationalize ideas'. Students were then able to further disseminate their generated knowledge by finding and presenting a solution to the whole group (A2, PG female). Through the process students communicated their ideas and supported each other's learning which in turn 'developed ownership' and 'increased motivation' (JR, PG male). A common refrain of students was that the opportunity to generate and disseminate knowledge in their group 'increased motivation to do a good job' (JR, PG male).

Pedagogical knowledge

In relation to students' pedagogical knowledge there were multiple reflections that indicated students had gained a deeper understanding of the principles and practices of group work in order to facilitate collaborative learning. These indicators of Pedagogical knowledge are identified in Table 2 as Declarative and Procedural knowledge to distinguish between students' statements that focused on *understanding* from those that focused on *implementation*. The following quotes are representative of many made in relation to students' teaching practice:

> (a) …there can be big problems with group dynamics. Especially as I experienced at teaching prac that the special needs kids are not wanted by other students in groups as they feel that these students slow them down. (A1, UG female)
>
> (b) Another positive which I would make use of in the classroom is the skills developed during the PBL process. Skills such as research skills, group work and presentation experience are all very valuable in both school and life situations. (A1, UG female)
>
> (c) A simple teaching strategy for inclusion is to incorporate group work into the classroom. Sounds easy enough? Not quite. As stated previously it is extremely important for teachers to have a solid understanding of the various dynamics that occur within classrooms so when selecting groups for group work there has to be some subtle selections on the teacher's behalf. (A2, UG male)

To what extent was collaborative learning a feature of students' group work experience?

To gauge the extent to which students' PBL group work was collaborative, the Summers and Volet (2010) key co-construction and co-regulation descriptors were used to analyse students' written reflections. For Assignment 1, 18 of the 28 postgraduate and 14 of the 30 undergraduate texts analyzed conveyed that students' group work experience involved collaboration. For assignment 2, collaborative learning was evident in nine of 17 postgraduate, and 15 of 29 undergraduate, students' texts. Of the 67 students who referred to collaborative learning in their final journal reflection on PBL eight were postgraduates and nine were undergraduates.

It was not always possible to tidily separate descriptors because some statements included both co-regulation and co-construction descriptors in the quoted excerpt. To represent the range of views expressed as fully as possible, each quote is from a different student.

Co-regulation was typically revealed through statements showing shared interactions and negotiation:

> In conducting this case study, my group excelled at it because we all used our strengths and researched topics that had meaning to us as individuals however when put together, we were a great team. This approach will be used in my class because I have had first hand experience of the power of having students take ownership and feel included. (A2, UG male)

And co-construction was exemplified in statements that recognized collaborative learning as a qualitatively different experience:

> (a) The group work I engaged in seemed different from other group work… I found that each member was more willing to take part in the problem solving, as we did not have all the information and had to learn from one another's experiences and points of view to get to the solution of the problem at hand. (A1, UG female)
> (b) At first I was a little confused about the process and its requirements. However, after the first few weeks I found myself engaging in a deep critical thought on issues very relevant to teaching and developing and contributing ideas to group and class discussions in an effort to solve or help solve the PBL case. (JR, UG female)

There were mainly positive but also some negative reflections in relation to the negotiation element of co-regulation with the more negative statements nevertheless conveying recognition of the potential of, and need for negotiation, to foster a collaborative environment:

> (a) I was initially skeptical about PBL but was won over by the process. It's an effective way of integrating knowledge but only one way. It's a good way of integrating learning with negotiated group activity. (JR, PG male)
> (b) Both the PBL cases seemed to be constrained by explicit and sometimes repetitive questions, whereas I felt our class would have greatly benefitted from more student-driven and negotiated questions. I actually highly enjoyed the basic process of PBL – it's just the execution of these that fell flat. (JR, PG female)

And in relation to learning more by working with others:

> There appeared to be a lack of clarity on how we were to go about problem solving. I guess the irony of it all is that through the PBL process our group learnt how to problem solve.

> The problem was not just the case study but it was in what processes and techniques can we use to solve problems. (JR, PG female).

DISCUSSION

The ASK framework has been successfully employed in previous research (Pourshafie & Murray-Harvey, 2013) and was used similarly in this study to capture the Attitude, Skills, and Knowledge dimensions of teacher education students' collaborative learning PBL experience. As learners and in relation to their future roles as classroom practitioners this research identified that collaborative learning supports a space conducive to exchange of ideas in a morally, socially and intellectually uplifting environment.

Drawing on the well-considered reflections of students that provided the data for this study, it was evident that for most, group work held meaning for them above and beyond the sense of task completion. Approximately half of the texts analysed, representing equal numbers of postgraduate and undergraduate contributions, indicated students had engaged collaboratively, in accord with the co-regulation and co-construction features of group work proposed by Summers and Volet (2010). One point of departure in our findings from research reported elsewhere of higher level cognitive processing through group work (see Schmidt et al., 2011) is that our students provided minimal reference to group work delivering benefits (or losses) in relation to higher level cognitive / metacognitive processing, using those terms. As suggested by Michaelsen and Sweet (2008) this may require that students receive explicit prompts to trigger their thinking about group processes; a reminder for teacher education PBL tutors to draw students' attention to the professional language of educators.

Adopting PBL in a teacher education context involves the need to focus attention on making explicit connections for students with both the teaching and the learning processes that underpin PBL; connections that students are required to reflect upon in light of their own future teaching practice. In terms of working with PBL in teacher education, notwithstanding that teacher educators are experienced and effective facilitators with expertise in the field of teaching and learning, the meta-teaching and meta-learning (Biggs, 1985) focus adds another layer of complexity to the PBL tutorial. It has been this meta-focus on PBL however that offered a unique opportunity to draw on the students' PBL experience.

The hesitancy, or low level of self-efficacy (see Bruner, 1997) for implementing effective group work, communicated by both undergraduate and postgraduate students serves to highlight that working with PBL is a demanding undertaking, for teachers as well as for learners. The students' expression of their pedagogical concerns nevertheless draws attention to two important points emerging from this study. The first is that teacher education students, through PBL, can come to appreciate the attitudes, skills and knowledge required for collaborative learning. The second point, based on comments that gave equal attention to

attitude, skill and knowledge dimensions of collaborative learning, is that the collaborative learning afforded by PBL offered students a holistic learning experience, and for this group of prospective teachers, a holistic frame of reference for professional practice.

There were no striking differences between undergraduate and postgraduate students' understandings about collaborative learning in that contributions from both groups were similarly amenable to classification in terms of the ASK dimensions and their sub-categories. With regard to pedagogical knowledge, undergraduate and postgraduate students alike could articulate links between the group work they experienced and possibilities for their own teaching. There were however, differences between the groups with postgraduate students indicating a deeper level of reflection about collaborative learning issues. This is not surprising since these more mature students, on average 10 years older than the undergraduates would have more life experiences to draw upon to make connections between learning and teaching. Notwithstanding this qualitative difference between the groups, it is not possible to say whether postgraduates worked more or less effectively within their groups than undergraduates. It could be considered a limitation of this study that only students' written work was available for analysis. Additional observational data of students' interactions would certainly strengthen findings by providing independent assessment of collaborative learning within the group. It is worthy of note that a minority of students whose texts were scrutinized expressed negative views about group work. Nevertheless, in describing what was unproductive or unsatisfying, in the main with reference to lack of skills for dealing with problematic group dynamics, they conveyed insightful reflections about collaborative learning regarding what could or should have been possible.

CONCLUSION

The PBL tutorial group, because it is purposefully embedded within the broader PBL process, creates opportunities to meaningfully develop knowledge, attitudes and skills pertinent to collaborative learning. Developing collaborative learning capabilities requires attention be given to building students' knowledge about effective teamwork, assisting students to make explicit connections between attitudes towards working collaboratively and achieving learning outcomes, and identifying with students, the specific collaborative learning skills required, and acquired through the process of group work. And according to these teacher education students, PBL helped to make explicit a range of learning and teaching processes that will inform their future teaching practice.

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Using Problem-Based Learning to help Portuguese students make the Bologna transition

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ABSTRACT

The Bologna Declaration has opened a stage of big and deep changes in the internal university organization, external cooperation, teaching models and methods, among other., all over the European countries. Here we will present and discuss a pilot experience conducted at the Engineering Department of the University of Trás-os-Montes e Alto Douro, Portugal, during the second year of that transition period. In brief, we will present a set of non-mandatory courses proposed to the students of each individual syllabus, with one hundred hours duration, each, approximately seven hours/week, fifteen weeks long, with the permanent help of a specialized trainer to aid the students in their "homework". The formal bureaucratic transition is also presented. Design and implementation issues, supported on problem-based learning and experimental lab learning classes, final assessment results, as well as the opinion of the students, are presented and analyzed. We believe that this methodology helped to make the transition smoother to the students, but also to the teaching staff.

Keywords: Bologna process, higher education, problem-based learning, experimental laboratorial learning classes

INTRODUCTION

The Bologna Declaration, signed back in 1999, has opened a stage of big and deep changes in the internal university organization, external cooperation, teaching models and methods,

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among other, all over the European countries. When additional variables are considered, such as financial constraints, the birth and dissemination of new tools and methodologies for the teaching/learning processes (e.g., distance learning), etc., these changes are in order to be happening in a very near future, if not happened yet.

In our view, and in accordance with Haug (2008), these changes reflect a desire to promote mobility and Europe as a world force in higher education in face of challenges from elsewhere in the world, and to establish the European Higher Education Area. This can only be achieved starting with a Europe-wide restructuring and harmonization of higher education and studies (Jacobs and van der Ploeg, 2006; Marks and Tesar, 2005). In the engineering education case, many studies are showing that a colossal work is being done throughout many different European countries (Munoz-Guijosa et al., 2009; Neal-Sturgess, 2007; Torres-Leza et al., 2004, to name only a few). Indeed, the achievement of Bologna's goals will only succeed if different national contexts are carefully considered.

Of course that the changes introduced with the Bologna process present important and big new challenges to the teaching/learning process in all Portuguese (and European) universities. Here we will present and discuss an initiative that was implemented at the Engineering Department of the University of Trás-os-Montes e Alto Douro (UTAD), Portugal, during the second year of the transition period. In brief, it consisted of a set of non-mandatory (volunteer) courses for each curriculum (with one hundred hours duration, each, approximately seven hours/week, fifteen weeks long, with the permanent help of a specialized trainer to aid the students in their "homework"), in order to try to make the transition smoother to the students, but also to the teaching staff (at least because of the necessary change of habits). Additionally, we believe that the results and discussion presented here will help in understanding that it is possible to share the human and material resources involved during the mastering of these curricula. The design of these courses was based on problem-based learning principles and experimental lab learning classes. Although this pilot experience has been successfully applied to the Electrical & Computers Engineering (ECE), Informatics (INF), Communication and Multimedia, Information & Communication Technologies (ICT), and Human Rehabilitation Engineering curricula, the discussion and results presented here will be focused on the ECE, INF, and ICT curricula.

The paper is organized as follows. In section 2 we present the formal/bureaucratic transition to Bologna in Portugal, and at UTAD and its Engineering Department in particular. Section 3 is used to present the experiential learning model that we have adopted to design the courses. In section 4 we present and discuss the non-mandatory courses that were proposed and in section 5 some of the results achieved. The paper ends with the presentation of some final remarks and conclusions, in section 6.

THE BUREAUCRATIC TRANSITION

According to Noam (1995) universities have three main functions: the creation of knowledge (research); the storage of knowledge (libraries); and the transmission of knowledge (teaching). It seems that the Portuguese higher education system is also organized according to these vectors, but it is being deeply restructured, particularly in what relates to the teaching and research dimensions. Some of these modifications are being imposed by changes in the Portuguese Law (e.g., DL7, 2006; RJI, 2007), and some others are being advised by the research funding policies dictated by the Portuguese Science and Technology Foundation (http://www.fct.mctes.pt/).

The Portuguese higher education system includes universities and polytechnic colleges. Now, and starting from the 2006/07 academic year with the effective publication of the Portuguese Decree-Law DL7 (2006) which marked the transition to the Bologna paradigm, we have three cycles of higher education: the first cycle "mobility degree" (Bachelors) is three years long; the second cycle "Master's degree" (MSc) after two more years of study; and the third cycle "Doctor of Philosophy degree" (PhD) with three more years. The majority of the curricula taken in polytechnic colleges only lead to "mobility degree" award. Also, no PhD degree can be provided by polytechnic colleges. In our opinion, there are two main reasons that greatly contribute to this: the lack of PhD teachers in the teaching body, and the lack of research centers to which the teachers are attached as researchers. These facts raise an important question that needs to be answered by the polytechnic schools: what to offer to the students that wish to pursue a PhD degree (and in some cases, even an MSc degree)? A solution to this problem may include the celebration of cooperation protocols between institutions.

The transition has also imposed an important reduction in the total number of contact hours per week (number of mandatory lessons per week), typically a reduction from about thirty hours to a little bit more than twenty; this reduction was achieved mainly by reducing the number of compulsory practical/laboratorial classes component. We believe that this reduction contributes to the moving of the center of the teaching/learning process from a "classroom/teacher" to "homework/student". Also, some flexibility in the curricula was introduced, in contrast to the traditional Portuguese way of teaching where the full curricula were already defined, tending to be very static with a very small number of optional courses for the student to choose, occurring mainly at the last (fifth) year of the old curriculum.

In all Portuguese universities, the different curricula were not adapted (or restructured) to the Bologna paradigm all at once; instead it had taken several steps or different phases (Cardoso et al., 2007). The universities have restructured their curricula in groups or sets. All the curricula were adapted by the end of 2009. At UTAD, a small university with about 8000 students located in northeast Portugal, this adaptation was done in three main phases: the first

included 15 curricula, 2006/07 academic year; the second 54 curricula, 2007/08 academic year; and the third, 31 curricula, during 2008/09 academic year. As we can see, 100 curricula were adapted to the Bologna paradigm, including first, second and third Bologna cycles.
The Engineering Department (ED) of UTAD has approximately 1700 students (including all cycles of teaching). Table 1 shows the main phases of the curricula's restructuring that the ED was responsible for. Although not shown in the table, we have restructured the two PhD curricula (Electrical & Computers Engineering, and Informatics) that the Department offered at that time.

Table 1 - The three phases of curricular restructuring at the Engineering Department.

Cycle	2006/07	2007/08	2008/09
1st	3	5	1
2nd	2	5	—

PEDAGOGICAL MODEL

Our pedagogical model is based on the Experiential Learning Model (ELM) of Kolb and Fry (1975), in conjunction with Problem-based Learning (PBL) (Hmelo-Silver, 2004; Barrows, 1986), and experimental lab learning classes. The ELM is composed of four elements: concrete experience; observation of and reflection on that experience; formation of abstract concepts based upon the reflection; testing the new concepts. These four elements are the essence of a "spiral of learning" that can begin with any one of the four elements, but typically begins with a concrete experience. This model emphasizes its links to ideas from John Dewey (1938), Jean Piaget (1941/1952), and others, writers of the experiential learning paradigm, and the importance of cooperation and interaction between students during their construction of learning (Vygotsky, 1978). This model was developed mainly for use with adult education, but has found widespread pedagogical implications in higher education.

PBL, which is a special case of "Inquiry-based learning" (Bruner, 1961), is being widely and successfully used to impart education in engineering (see, for example, Maskell and Grabau, 1998; Johnson, 1999; Mandal et al., 2000; Ditcher, 2001; Cheng et al., 2003; Prince, 2004; Dunlap, 2005; Smith et al., 2005; Prince and Felder, 2006; Hsieh and Knight, 2008). Although applications of PBL vary, it has three essential characteristics: problems as a stimulus for learning; tutors as facilitators; and group work as stimulus for interaction. Some researchers argue that this model has the potential to prepare students more effectively for future learning, because it has its roots on the above mentioned ELM, and it is with characteristics of being: constructive, self-directed, cooperative, and contextual. However, the detractors concluded that PBL students showed potentially significant gaps in their cognitive knowledge base and did not demonstrate expert reasoning patterns, and that PBL was very costly (Albanese and Mitchell, 1993).

PBL goes beyond the typical teaching methodology by promoting student interaction. Students are assigned to teams and provided with an "ill-defined" problem. Teams must organize themselves, define objectives, assign responsibilities, conduct research, analyze results, and present conclusions. PBL (Woods, 1994), can be seen as the process of using a problem situation to focus the learning activities on a need-to-know basis. This contrasts with subject-based learning, where the students are presented with discipline-based material and are then given a problem (or example) of its use. As put by Maskell and Grabau (1998), "PBL is ideal for engineering education as it encourages a multidisciplinary approach to problem solving (which is essential for modern engineering practice) and develops techniques and confidence in solving problems which have not been encountered before". PBL naturally integrates various fields of study as students search beyond the traditional curricular boundaries to develop solutions. Also, combining PBL with cooperative learning (Johnson et al., 1991; Smith, 1995) provides a mechanism for students to maximize their own and other group members' learning by working in teams to accomplish a common task or goal. Consequently, the proposed methodology is not limited to paper study, allowing the use of multimedia methods, including the use of different engineering tools, such as the ones reported in Reis and Ferreira (2004), Nobre et al. (2009), and Baptista et al. (2011).

THE COURSES

Because specialization within science and engineering degree programs results in students entering engineering curricula at UTAD with considerable differences in knowledge skills, it was decided to implement the courses as cooperative PBL ones, so that students could work together to maximize their own and each other's learning, and consequently during experimental laboratorial learning classes. In addition, the groups were selected at random from the different degree programs and, in general, consisting of two members.

After lecture notes have been read, it is necessary to try a simple exercise to evaluate whether the students have grasped a concept; as stated by Cheng et al. (2003), "In order to attract user interaction, the exercises must be simple, straightforward, and taught through the lecture notes". So, during the courses sets of small problems were designed and authenticated by senior teachers, and given to students. These problems are not truly open-ended but broad enough to serve the purpose. Probably, the greatest challenge in PBL is to create sufficiently broad and, at the same time, well defined problems so that the entire course curriculum is covered. Creating several smaller artificial problems concerning a few well-defined details is often easier than creating a larger one covering several predetermined topics. However, we must remember that some students may feel that PBL is too demanding, especially if PBL is applied directly without modification, because it requires students to learn a subject through their own study. This is especially difficult for the Portuguese students who have been using theoretical classroom teaching for a long time, which could be called "first time" PBL students, and so the application of a model like the "Aalborg model" (which gives the

students the possibility for independent learning to achieve knowledge and skills at a high academic level) would be impossible (even for the teaching staff). So, the proposed set of problems during each individual non-mandatory course can be seen as modified-PBL: the necessary information is given to the students, but still retain some degree of self-searching.
The non-mandatory courses have one hundred hours duration, each, approximately seven hours/week, fifteen weeks long, with the permanent help of a specialized trainer to aid the students in their own work, and was linked to one or more mandatory course of the graduation curriculum. The chosen mandatory courses were the ones where students traditionally were having more difficulties, but several other academic issues were also considered, such as coordination between courses taught, adequate subject knowledge on the part of teachers, coordination between departments and lecturers in charge of courses, overlap between courses, and so on, before the courses were designed. Particular emphasis was given to the coordination between the different courses' contents, in order to promote complementarity and give students more time and space to practice and solve their problems, and reflect on how the different parts fit together, contributing to the desired solution. Other problems solved were the ones arising from factors such as the excessive number of tests or exams that students have to take by the end of the semester, forcing them to skip classes to study for those exams, or the coordination problems caused by the holidays.

The teachers of the mandatory courses (senior-teachers) were responsible to master the different subjects, encouraging the students to do their practical "homework" in the non-mandatory courses, with the help of the specialized trainer. The classrooms where the students attend these non-mandatory courses were specially equipped with multimedia equipment, like desktop computers and multimedia projectors; the teachers and the specialized trainers always have access to this equipment and also laptop computers. This kind of organization promotes the permanent interaction between the students and the teachers/trainers, the pedagogical group being augmented in the role of learner facilitator.
The student attendance in a classroom context will help him/her to better understand the foundation information, which will enable the student in its reflection, progression and action plan development. In order to better implement the students' plan, the specialized trainer (and the senior-teacher) helps the students in their groups (of two, and in some cases three), but also individually. These groups will also help the students to understand and learn how to do "team-work" (of course that the trainer must see him/her-self as an adviser). This approach allows working in a classroom context, fostering the "learn-by-doing", allowing for individualized pedagogic support, and promoting learning by putting theory into practice. Like Aristotle once said "For the things we have to learn before we can do them, we learn by doing them" (Bynum and Porter, 2005, 21:9).

Table 2 - Non-mandatory courses and mandatory courses actually contributing to their mastered contents (1st semester).

Non-mandatory courses	**Mandatory courses**	**Curriculum & Year**	**Proposed**	**Mastered**	**Students**
ICT Introduction	Computational Logic Seminar I	INF & ICT 1	5	6	86
Advanced Computer Programming	Programming Methodologies II Informatics Laboratory II	INF & ICT 2	5	4	66
Information Systems	Information Systems I Informatics Laboratory II	INF 2	1	2	31
Web Technologies	Programming Methodologies IV Informatics Laboratory IV Data Bases	INF & ICT 2	4	2	36
Information Systems Administration	Computer Systems Administration	INF & ICT 1 (MSc)	1	2	30
Computational Laboratory I	Control Systems Data Communication	ECE 3	3	3	51
Operating Systems Laboratory11	Operating Systems	ECE 3	3	1	11

Table 2 shows the first semester 7 non-mandatory courses and their corresponding 13 mandatory courses in the corresponding curricula. Also shown are the curricula and academic year of the students applying to the course. Note that the "Information Systems Administration" non-mandatory course was applied to "Master level" students, both from INF and ICT curricula. The listed mandatory courses are the ones directly contributing to the contents mastered during the non-mandatory courses, that is, not the ones that could contribute with contents, but rather the ones where it was possible to put the senior teachers responsible for their mastering together, and agreeing with the contents and "homework" to be done by the students. The "Information Systems" non-mandatory course was offered, as all the others, to the students of both INF and ICT curricula, but only students from INF applied to the course; students from ICT curriculum applied to this course only in the second semester. Also note that the number of proposed non-mandatory courses is not coincident with the number of actually mastered, because the number of students wanting to attend the courses was different from the one that we have expected; the grand total was 22 proposed and 20 mastered courses. Also we had 311 students attending the non-mandatory courses during the first semester.

Table 3 shows the second semester 7 non-mandatory courses and their corresponding 11 mandatory courses in the corresponding curricula. As we can see, the "Digital Image Concepts" non-mandatory course was applied to "Master level" students, both from INF and ICT curricula. Note that the "Information Systems" non-mandatory course was now offered to the students of the ICT curricula. The total number of proposed non-mandatory is now 19, but we have actually mastered 23 courses, due to the number of students wanting to attend these courses; in total we had 333 students attending the non-mandatory courses during the second

semester. As we can see, there was an increment of almost 10% in the number of students attending the non-mandatory.

For the sake of brevity, here we present only the main objectives of the "Computational Laboratory I" non-mandatory course. Its main aims are: overview of the Microchip 8-bit PIC family; peripherals and records; configuration registers; peripherals, I/O ports, asynchronous serial port, ADC, counters and timers; interrupts, I/O port and timers.

As noted above, during the classes different sets of small problems were proposed, and a final bigger ("ill-posed") problem at the end of the course. As an example, table 4 presents the set of tasks/problems proposed to the students of the "Computational Laboratory I" non-mandatory course. As we can see from table 4, most of these problems can be regarded as tasks, i.e., small steps to be taken towards the route that leads to the final solution. Table 5 presents the final proposed problem to the students attending this non-mandatory course. As we can see, a big part of the required work was done during the smaller tasks/problems listed in table 4. This is an "ill-posed" problem; surely, there will be groups students with "more complete" (and complex) solutions, but all the groups of students may reach a suitable solution.

Table 3 - Non-mandatory courses and mandatory courses actually contributing to their mastered contents (2nd semester).

Non-mandatory courses	**Mandatory courses**	**Curriculum & Year**	**Proposed**	**Mastered**	**Students**
Information Systems	Information Systems II	INF 2	2	2	31
Digital Image Concepts	Digital Image Processing	INF 1 (MSc)	1	1	21
Computer Programming I	Programming Methodologies I Informatics Laboratory I ICT Laboratory I	INF & ICT 1 (MSc)	5	6	69
Computer Programming II	Programming Methodologies III Informatics Laboratory III ICT Laboratory III	INF & ICT 1 (MSc)	3	4	72
Computer Networks	Computer Networks	INF & ICT 3	4	6	84
VLSI CAD	Electronics and Computation Laboratory	ECE 2	2	1	11
Computational Laboratory II	Telecommunications	ECE 3	2	3	45

Table 4 - List of problems/tasks presented to the students during the "Computational Laboratory I" non-mandatory course.

I/O
1. Write a small program that puts the DS1 LED flashing.
2. Write a small program that lights up the LEDs from left to right.
3. Write a small program that lights up the LEDs from left to right, and then form right to left.
4. Write a small program that: while SW1 switch is pressed the DS1 LED lights up, and when SW1 switch is released DS1 LED will turn off.
5. Write a small program that lights up the LEDs from left to right, and when SW1 switch is pressed the LEDs will light up from right to left.
6. The same as 1.5, but using Port A interrupts.
ADC
1. Write a small program to configure the ADC to the following values:
a) Channel: AN0;
b) Reference voltage: Internal;
c) Sampling frequency: Fosc/8.
The program should read the ADC output value and store this value in Volts.
2. Write a small program to read a sensor temperature value connected to RA1 pin.
3. Implement a digital voltmeter using the input pin RA0 and LEDs DS0 to DS7.
Timer
1. Write a program that will put the DS0 LED flashing exactly every second.
2. Implement a digital voltmeter to make acquisitions of 200ms.
3. Implement a frequency meter, to measure the frequency of a signal applied to pin T0CKI.
4. Implement a state machine to control the DS0 LED. The following states should be implemented: readSwitch, turnonTunroffLED.
USART
1. Write a program to send character 'A' from the development board to a PC.
2. Write a program that allows a PC to control the SD0 LED. Implement the options: turn on the LED, and turn off the LED.
3. Write a program to connect two development boards using USART serial communication capabilities. One of the boards should control the DS0 LED of the other board, turning it off and on by pressing the SW1 switch.

Table 5 - Final problem proposed to the students attending the "Computational Laboratory I" non-mandatory course.

Develop a program to control and monitoring the temperature and brightness of a room. The following sensors should be used: LM50 for temperature, and TSL 2550 for the following characteristics: port to turn on/off the heating. The program should include the temperature it will be used a fan for cooling and an output brightness. To control
1. The control should be implement using a state machine with the following states (with a range of 100 milliseconds):
a) readTemperature;
b) readBrightness;
c) controlHeatCool;
d) sendDataPC;
e) searchPCRequests.
2. The temperature should not fall below 15^{o} C nor rise above 27^{o} C degrees. Once activated, each driver must be turned on, at least, 1 minute, regardless of the hysteresis in the operation.
3. The information collected by sensors and state of the actuators should be sent to the PC each cycle of the state machine (Baud 9600).
4. The PC may start and stop the operation of the entire system; so, it will be necessary to implement the code to accept PC's requests.

Table 6 - Global final (end-of-semester) assessment results of the mandatory courses, for the first semester.

Mandatory courses	Enrolled	Attending non-mandatory courses						Non-attending non-mandatory courses					
		Total	Succeeded		Non-succ.		lacked	Total	Succeeded		Non-succ.		lacked
			total	class	total	class			total	class	Total	class	
Computational Logic	128	81	52	13.1	19	6.9	10	47	13	14.5	6	7.5	28
Programming Methodologies II	121	65	30	12.0	34	2.0	1	56	11	11.0	43	1.0	2
Programming Methodologies IV	50	27	22	12.4	3	7.0	2	23	15	11.9	3	6.7	5
Computer Systems Administration	49	30	19	12.7	11	5.3	0	19	4	15.0	1	2.0	14
Seminar I	124	77	77	15.4	0		0	47	19	14.7	0		28
Informatics	125	81	49	12.4	14	4.1	18	44	4	12.5	2	2.0	38
Informatics Laboratory II	93	53	34	12.4	10	5.7	9	40	8	10.3	2	4.6	30
Informatics Laboratory IV	47	27	26	12.8	0		1	20	17	12.9	0		3
Information Systems I	53	31	16	12.4	9	6.8	6	22	1	13.0	2	6.5	19
Data Bases	45	24	24	12.5	0		0	21	13	12.4	2	7.0	6
Control Systems	52	51	51	14.4	0		0	1	1	12.3	0		0
Data Communication	19	15	15	13.4				4					4
Operating Systems	32	11	11	15.6	0		0	21	7	12.2	2	5.7	12
Total	938	573 61%	426 74%	13.2	100 17%	5.4	47 8%	365 39%	113 31%	12.7	63 17%	4.8	189 52%

RESULTS

Table 6 shows the first semester global final (end-of-semester) assessment results of the mandatory courses that contributed to the contents mastered in the non-mandatory courses. Note that both students attending and non-attending the non-mandatory courses have taken the same final (end-of-semester) exams. From the grand total of 938 students enrolled in the mandatory courses, there were 573 (61%) students attending the non-mandatory courses and 365 (39%) not attending any of these courses; the same student may be enrolled in more than one course, i.e., we do not have 573 different students, and this too applies to the ones not enrolled. To analyze the data presented in this table we begin to notice that the total number of students attending the non-mandatory courses is 22% higher than the ones not attending. The average grade (labeled “class.” in the table), for the students attending the non-mandatory courses, is better for seven mandatory courses (Programming Methodologies II, Programming Methodologies IV, Seminar I, Informatics Laboratory II, Data Bases, Control Systems, and Operating Systems); for the ones succeeded, the total average was 13.2 (in 20) for the

attending students and 12.7 (in 20) for the non-attending students; for the ones not-succeeded the average was 5.4 (in 20) for the attending students and 4.8 for the non-attending students.
Also, we note that the number of students labeled "lack" (students that had given-up, missed or that do not have the minimums required to do the final exam, and consequently fail) was bigger in students not attending the non-mandatory courses (47/8% students attending the non-mandatory courses, and 189/52% students not attending the non-mandatory courses). In total there were 426/74% succeeded students attending the non-mandatory courses, and 113/31% succeeded students not-attending the non-mandatory courses. Also there were 100/17% non-succeeded students attending the non-mandatory courses, and 63/17% non-succeeded students not-attending the non-mandatory courses, in total.

Table 7 - Global final (end-of-semester) assessment results of the mandatory courses, for the second semester.

Mandatory courses	Enrolled	Attending non-mandatory courses						Non-attending non-mandatory courses					
		Total	Succeeded		Non-succ.		lacked	Total	Succeeded		Non-succ.		lacked
			total	class	total	class			total	class	total	class	
Information Systems II	31	31	29	15.2	2	8.7	0	0	0		0		0
Digital Image Processing	21	21	21	14.3	0		0	0	0		0		0
Programming Methodologies I	147	69	65	13.8	2	6.7	2	78	40	13.3	30	5.6	8
Informatics Laboratory I	82	67	60	13.9	7	6.4	0	15	7	12.2	4	7.2	4
ICT Laboratory I	63	60	58	12.4	1	7.3	1	3	2	13.2	0		1
Programming Methodologies III	104	72	69	11.9	2	6.5	1	32	15	12.1	2	7.1	15
Informatics Laboratory III	29	29	28	13.2	1	7.8	0	0	0		0		0
ICT Laboratory III	39	38	38	12.8	0		0	1	0		1	6.8	0
Computer Networks	84	84	75	12	5	5.6	4	0	0		0		0
Electronics and Computation Lab	33	11	11	14.2	0		0	22	9	12.8	9	4.5	4
Telecommunications	80	45	43	13.2	2	6.5	0	35	15	12.7	10	5.8	10
Total	713	527 74%	497 94%	13.4	22 4%	6.9	8 2%	186 26%	88 47%	12.7	56 30%	6.2	42 23%

As we can see from the values presented in table 7, there were 527 (74%) students enrolled at least in one non-mandatory course, which corresponds to an increment of 13% from the first to the second semester. From these students, 94% were succeeded in the final exam, contrasting with the 47% of the succeeded students not attending any of the non-mandatory courses. Note also an increment of 20% in the number of succeeded students attending the non-mandatory courses, and a reduction of 13% in the number of succeeded students not-attending any of the mandatory courses. The percentage of non-succeeded students was 4% for the ones attending non-mandatory courses, and 30% for the ones not attending. For the students that had lacked the final exam we have 4% and 23% for the ones attending and not attending, respectively. In what concerns to the final total average grades, we can see that they

are all better for the students attending the non-mandatory courses than for the students not attending them, except for the "ICT Laboratory I" and "Programming Methodologies III" courses, where the final averages are better for the students not attending the non-mandatory courses; although this is true, one must note the small number of students (3) not attending the non-mandatory courses for the "ICT Laboratory I" course.

Comparing the total number of students enrolled with at least one mandatory course during the first and the second semester, we can see a reduction of 24% (from 938 to 713), but this reduction was not fully reflected in the number of students attending the non-mandatory courses, which was of 8% only. This fact is even reinforced when we compare the number of mandatory courses contributing to the non-mandatory courses, which was of 13 in the first semester and of 11 in the second semester.

During the academic year we have also conducted a set of fifty semi-structured interviews to the students, in order to have some feedback and possible correct some of the choices that we have made. The data were collected and analyzed according to the methodology proposed by Bardin (1977). In global terms, we have reached the following major conclusions: first, the students were not used with the new methods of learning/working; second, they are enrolled with too many courses at one time; third, due to the number of different courses, plus the non-mandatory ones, they are having time-table (scheduling) problems; fourth, in the case of MSc level, some of the students are already employed; fifth, the difficulty level imposed on the MSc thesis by some advisors (which were used with the old MSc figurine), is to high (recall that the former MSc degree was preceded by a five years curriculum, plus one more year of lectures, which ended up with the dissertation's writing, and that by now it is after a three years curriculum, followed by one more year of lectures, and a final year to write the dissertation, but also with mandatory lectures, i.e., a reduction of two years). Some of the individual testimonies reinforce these facts: when asked if they are used to this methodology the answer was invariably "no", and that they "rather prefer this kind of approach, instead of more theoretical ones" (interview # 5) or "it really helped me understanding some basic facts and guiding and programming/scheduling my study" (interview #45) and "this (initiative) helped me with more (mandatory) courses than I was expected, even though I almost have no extra time for anymore courses" (interview #25). Also, the students feel that "besides it particularly helped me in my different courses, it also entailed a kind of approximation between the students and the teachers" (interview #12), and that "even though I'm still convinced that my MSc advisor is pushing the level to high, I feel that now I'm more close to him than before" (interview # 2). In line with these opinions, "the (non-mandatory) courses helped me to see «the big picture», and how things relate to each other" (interview #40), "this gave me extra motivation to purse my objectives, because every time I have any question I can go to the teacher or the trainer and ask them what to do; I feel they are always close to me" (interview #20), or "I was really thinking quitting one or two (mandatory) courses (because of the great number of mandatory courses I was enrolled with), but the words,

patience and support of the trainer stimulated me to continue and not given up" (interview #23). It is worth to note that students feel that the curricula are better after the Bologna restructuring (e.g., "I think that the subjects mastered along the several courses are more linked between them than before" (interview #5) or "now, things make more sense" (interview #15), "now I can see I how the different subjects mastered along the different courses fit together" (interview #39). Also, in their opinion, this kind of initiative should be encouraged and maintained, mainly because of the help they had during their "homework" and the feeling of "proximity to the teaching staff".

CONCLUSIONS

The transition to the Bologna paradigm was very sharp, and both students and teachers still have much and hard work to do. Here we have presented a methodology intended to particularly help the students in this transition. It was successfully applied to students from Electrical & Computers Engineering, Informatics, and Information & Communications Technologies curricula, at the University of Trás-os-Montes e Alto Douro. As we can see from the data presented above, the students adhered to the initiative. Recall that the method used was not purely problem-based learning, but an adaptation of that kind of methodology, using experimental laboratorial learning classes, whenever and wherever possible using ICT tools and trying to move to a framework like the one proposed by Tambouris et al. (2011). We believe that these courses provided a basis for developing team skills in engineering classes and improved both student and teaching staff morale.

The methodology applied had indeed helped the students to succeed the mandatory courses. Recall that, for the first semester, 74% of the students attending the non-mandatory courses were succeeded in the mandatory courses, in contrast with the 31% of the ones succeeded but not-attending the non-mandatory courses. These numbers were even sharper for the second semester: 94% and 47% for attending and not attending the non-mandatory courses, respectively; note the increment of 20% in the number of succeeded students attending the non-mandatory courses. In our view, these better results can be mainly attributed to the extra motivation students gained when they feel they are "physically" (closely) accompanied by the specialized trainer, and they have more time to practice and solve the problems in a more "tutorial-like" and supported basis, as can be concluded from the transcriptions of the interviews presented in the previous section. Also, the contribution to the lower percentage of students giving up, missing, or that do not have the minimums required to do the final exam, and consequently fail the final exam, was higher in the group of students attending the non-mandatory courses; first semester, 8% and 52% (attending and non-attending, respectively), second semester, 2% and 23% (attending and non-attending, respectively); this is particularly evident from the interview transcriptions in the previous section. What's more, the students feel that this initiative helped them doing the "true transition" to the Bologna paradigm.

In summary, and using the students' own words, "(I) rather prefer this kind of approach (PBL), instead of more theoretical ones", "it really helped me understanding some basic facts and guiding and programming/scheduling my study", "(…) helped me to see «the big picture» (…)" and "I was really thinking quitting one or two (mandatory) courses (because of the great number of mandatory courses I was enrolled with), but the words, patience and support of the trainer stimulated me to continue and not given up".

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Problem Based Learning in Continuing Education – Challenges and Opportunities

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ABSTRACT

This article presents the PBL model applied at Aalborg University in order to discuss research findings with regard to the educational effectiveness of the PBL model in securing an efficient transfer of learning from university driven continuing education to the context of the workplace. In recent years Aalborg University has seen a progressive PBL development with regard to our many new continuing educational programs. The empirical data applied in the article is collected from two qualitative Ph.D. studies. Drawing on research findings from these studies, we discuss why the PBL model, in spite of the intentions of closing the gap between education and working life, seems to have some important challenges. The discussion concludes by suggesting some pedagogical guidelines for the design of future PBL organized academic activities within continuing education.

The Danish government passed its first reform on continuing education in 1965. Since then continuing education has become an integral part of the Danish labor market and one of the fastest growing industries. Today no country in Europe has a higher percentage of people between 25 and 65 attending public funded educational activities (Eurostat). Even so, Danish Universities have been somewhat reluctant to engage themselves in activities regarding continuing education (Rasmussen, 2012). However, in the year 2000 the Danish government passed the most important reform concerning adult education in recent history with its most important element being a creation of a new system of vocational adult education for all levels of education. Among other initiatives the reform prompted the universities to engage in

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a wide range of educational activities within continuing education. The primary activity is the so called master programs, which is parallel to the *candidatus* level in the ordinary educational system. Apart from these programs almost all universities in Denmark today experiment with new ways of thinking in terms of continuing education, collaborating with companies and organization in order to create academic learning opportunities outside the traditional university auditorium. From the very onset Aalborg University (AAU) decided that activities within continuing education, like all other educations, should be rooted in a Problem Based Learning (PBL) framework. PBL has evolved and proven itself as a valid and quite effective educational strategy within the ordinary educational system. The question at hand is: will PBL prove just as successful when it is employed within continuing education?

In this article we deal with two different programs within continuing education, both located at Aalborg University. Both programs are based upon the principles of problem based project work. With these two cases as our point of reference we will discuss whether a PBL approach is an appropriate didactic strategy in continuing education in order to promote transfer of learning. In our Analysis of the differences between intended and actual learning outcomes we reflect on possible contradictions between the 'seriousness' of work and the 'playful nature' of education. On this point we draw on the concept of 'play' as developed by Gregory Bateson (1972), as well as the distinction between contexts of 'reproductive" – and 'developmental learning'. In conclusion we will also touch upon challenges for PBL as well. Initially we will provide a short introduction to the Aalborg PBL model being the basis for all educational activities at Aalborg University and to the concept of transfer of learning, a concept that is indeed relevant to all educational activities but especially continuing education. With this theoretical point of reference we present our cases based on two Ph.D. studies and discuss their relevance in terms of the presented theory. From this discussion we finish with some concluding remarks regarding the future of PBL in continuing education.

THE AALBORG PBL MODEL AND THE CONCEPT OF "PROBLEM"

PBL was introduced in Denmark in the early 1970s when Aalborg University (AAU) and Roskilde University Centre (RUC) were established. At Aalborg University the more general characteristics of PBL (Savin-Baden & Major, 2004) were transformed into what is called 'the Aalborg PBL Model' (Barge, 2010).

'The Aalborg PBL model' combines *problem orientation* where problems or wonderings appropriate to the educational program serve as the basis for the learning process, with *project organization*, where the project stands as both the means through which the students address the problem, and the main learning context of the students. Hence, the students are expected to "argue for, select, apply, and assess specific theories and methods in regard to their appropriateness for dealing with the specific problem they have chosen for their area of inquiry" (Jørgensen, Strand & Thomassen, 2012; Kolmos, Krogh & Fink, 2004; Kjersdam &

Enemark, 1994; Laursen, 2004; Barge, 2010). A very important aspect of 'the Aalborg PBL model' is the aim to take the problems of the practical everyday life as the study´s point of departure and to consider academic knowledge as a tool in understanding and analysing the problem (Ulriksen, 1997). In the course of developing the AAU model of PBL, the question of which qualities a 'problem' should have in order to fulfil its pedagogical functions, has been much contested. From the beginning the importance of letting the students work with "real problems" from the "real world outside the university" has been underpinned. At the same time others have stressed the point, that the problem should express the students' 'astonishment' or 'cognitive disturbance' in the context of the relevant academic disciplines (Adolphsen, 1992). In other words, a problem should not only be a 'problem' in a pragmatic or technical sense of the word; it should also be an unsolved mystery seen in the perspective of relevant scientific knowledge and understanding. In short, the critique of the PBL model as a strategy for university teaching is that it primarily produces practitioners without a solid and wide spread academic theoretical foundation (Colliver, 2000). Even though recent research rejects this postulate (Schmidt et al., 2009; Schmidt et al., 2012) the challenge of connecting theory without privileging one paradigm at the others expense is an ever present task for teachers and educators.

TRANSFER OF LEARNING

Transfer of learning can be identified as the process in which knowledge is acquired by a person and afterwards transferred from one context to another, across time and circumstances (Laursen & Stegeager, 2011). The concept of transfer is especially relevant in this article since all educational activities are based on an (more or less) implicit notion of learning transfer. This is especially true in continuing education where the ultimate goal is to enhance the working skills of the student. For this reason, an understanding of the concept of transfer and the process is essential for everyone involved in adult education.

In short, transfer can occur when a learner applies what was learned to new situations. Even though this might sound obvious, many people have experienced that this correlation between learning and application is not always problem-free. These problems are generally referred to as *the problem of learning transfer.* This issue was originally addressed in an acclaimed article by E.L. Thorndike and R.S. Woodworth (1901) where they promoted their theory on identical elements. They claimed that transfer is only likely to occur in cases with a high degree of similarity between learning context and application context.

Quite a few other scholars have challenged this position. An early sceptic was C.H. Judd whose article from 1908 promoted another view on the transfer problem. Judd had little interest in the transfer of specialized skills from one setting to a more or less identical setting. Instead his scientific work focused on the transfer of general and abstract knowledge. In his research he demonstrated how subjects used the general understandings of abstract

phenomena such as mathematics and algebra to solve concrete problems in situations with which the subjects had no prior experience. This lead him to postulate that educational activities' primary aim should be to provide students with generalized and abstract knowledge, which could afterwards be applied on problems in varying contexts.

The transfer literature describes this distinction between the position of Thorndike and Judd as the question of specific vs. general transfer (Leberman et al., 2006). The distinction has been the focal point in many pedagogical controversies: "How should you structure your teaching in order for your students to be able to use their learning in other contexts?" In Denmark the vocational schools have to a high degree focused on teaching that promotes specific transfer. Many classrooms simulate the conditions of the working context (restaurant, garage, etc.). Universities on the other hand have always advocated in favour of the importance of teaching of abstract 'decontextualized' knowledge, and have thus promoted strategies aiming at general, complex transfer. This is evident in the way teaching at universities is traditionally structured with focus on lectures and exams centering on abstract knowledge subjects. The rising interest in academic continuing education has thus forced a new challenge upon the universities motivating them to adopt a teaching strategy that promotes specific as well as general transfer. At Aalborg University the answer to this challenge has been problem-based, project organized learning.

PBL AND TRANSFER

As stated earlier, the implementation of PBL as the dominant model of teaching and learning at Aalborg University was based on the assumption that PBL is an effective didactic means for minimizing the problem of learning transfer. Some of the most important assumptions hold, that it is possible to create transfer from PBL organized, academic study programs to the practical world of working life in the following areas:

- The ability to structure ill-structured problems.
- The ability to plan-, organize- and evaluate processes of complex teamwork.
- The ability to select, analyze and use theories, models and research data to accomplish practical tasks (Laursen, 2013).

Multiple studies have shown that PBL is effective in enhancing student learning, compared to traditional lecture-style teaching (Schmidt et al., 2012), but does it enhance transfer as well? Recent studies, primarily within the field of medicine, have indicated that such a connection between PBL and learning transfer might exist. In a study involving 47 students enrolled in a vocational nursing program Mathews (2011) found that problem-based learning enhanced students' knowledge and ability to apply that knowledge. Kennedy (2007) found similar results in her study of students in an advanced pathophysiology course. Both studies compare

PBL with traditional teaching methods and conclude that a problem-based learning approach is superior in order to enhance learning and application of that learning in other contexts.

Research conducted in medical programs with gifted students point out that the problem solving skills developed during PBL-organized formal educational situations are successfully transferred to practical orientated situations. Williams (1993) reports that studies on knowledge acquired in a PBL organized, formal curriculum indicate that skills and knowledge were effectively transferred to work environments. Gallagher, Stepien, and Rosenthal (1992) found that PBL-organized courses improved the students' potential to identify problems in ill structured tasks and situations, compared to more traditional educated students.

Other studies, though not making comparisons with more traditional teaching methods, seem to support the notion that PBL is a legitimate way of teaching for transfer. In this respect Ljung and Blackwell (1996) describe Project OMEGA, a program for at-risk teens that combines traditional instruction with problem-based learning. The authors report positive transfer following enrolment in Project OMEGA for a vast majority of the students. Even though the number of studies focusing on the relationship between PBL and transfer of learning are by no means overwhelming most studies seems to support the thesis that PBL *does* enhance transfer between education and work. But which qualities in PBL might be responsible for this correlation? With reference to Thorndike's theory of identical elements, an argument could be that the solving of practical "real life problems" will enhance the students' abilities to solve similar problems after their graduation. In the same respect PBL should enhance the students' skills when it comes to project-based group oriented tasks. Most of these assumptions are confirmed in a large study from Aalborg University with 4477 graduates (Kandidatundersøgelsen, 2002). In this study students within humanities and the social sciences were asked which competencies they had acquired during their five years at University. The most common answers were the ability to work with problems and the ability to work in a project oriented manner. Others have focused on the cognitive learning basis of PBL. However, the study also found a negative match between the practical demands of working life and the competencies acquired in the context of academic stings, when it comes to the ability to endure working under stress and to handle time pressure, as well as the ability to work independently on an individual basis (Kandidatundersøgelsen, 2002; Laursen, 2013).

In a literature review Schmidt et al. (2011) found considerable support for the idea that PBL is an effective learning strategy within the academic field of medicine as it encourages the activation of prior knowledge in a small-group setting and provides opportunities for elaboration on that knowledge. They also found support for the hypothesis that working with problems create a desire in students to find out more about the topic, which leads to increased concentration, focused attention and a willingness to learn (Ibid.). However, some researchers have pointed out that teaching methods, such as the PBL, which call upon a high degree of independent student work requires a high level of competence among students. If these

competencies are not present these methods might end up being counterproductive and directly obstruct the intended learning outcome (Kirschner, Sweller & Clark, 2006). Snow & Lohman (1984) suggests that students, depending on their level of competence, will benefit differently from either a more or less structured pedagogical structure. Thus, high-ability learners will benefit from a loose didactical structure that allows the students' to shape and control their direction of learning. Low-ability students might reach better learning outcomes when the teaching is more structured and controlled by the teacher. On the other hand, these hypothesis are contradicted by research showing that Aalborg University and Roskilde University are way ahead of the more traditional lecture based universities in Denmark when looking at completion rates for student with a non-academic background (Thomsen, 2005; Schmidt et al., 2009) found that a PBL curriculum decreased dropout rates as well as completion time for medical students.

As the research presented above shows, some arguments can be made supporting the claim that in fact the Aalborg PBL model does enhance both learning and the transfer of learning. Yet it is worth noticing, that most of the mentioned studies were made within the ordinary educational system since studies of PBL in adult education is almost non-existent. With this in mind it seems relevant to ask, whether the same connection between PBL and transfer of learning can be found within continuing education? The following two cases seek to elaborate upon this question.

MASTER IN LEARNING PROCESSES – WITH SPECIALIZATION IN ORGANIZATIONAL COACHING

At Aalborg University the first Master educations were established in 2001 almost immediately after the passing of the reform on continuing education. The Master in learning processes was one of the first pedagogical oriented Master Programs. It was launched in February 2001 and has existed ever since. In 2008 a specialization in Organisational coaching was added. This specialization has managers and consultants as its primary market segment. Like all other Master programs it is a part-time education. The students attend the education throughout four semesters corresponding to one year of full-time study. The education is based upon the principles of PBL. Each semester has a specific thematic framework, which the students use to frame projects in real time using their own work environment as the setting for experimentation and learning. The students can work alone or in project groups. The primary educational idea is that learning should unfold in the interaction between the theoretical oriented classroom and the production oriented workplace (Willert et al., 2011).

The research project was carried out as a qualitative study where 19 graduates[1] from the first two classes were followed throughout their two years of studying. They were thoroughly

[1] The classes are rather small. 36 students enrolled at the Master Program during the two years, and the research project comprises all the students that actually did finish within scheduled time.

asked to submit their expectations in terms of expected outcome prior to the educational start and to evaluate the education as well as their own learning when finishing two years after. Furthermore, their Master theses were included as examples of the PBL activities undertaken by the students[2]. Finally, one year after graduation a semi-structured interview was conducted with the former students in order to inquire into their perception on topics such as what they had actually learned, how they had strived to apply this learning in the daily work and their view on different didactic approaches applied by the Master program in regard to the transfer process[3]. In this paper we will only touch upon a few selected aspects, concerning the relationship between PBL and transfer of competencies between education and work.

Table 1 - Thesis Overview

Title	Number of students	Problem formulation	Empirical or theoretical thesis	PBL in own organization?
Professional Coaching concerning multi complex tasks in elderly care	1	How can learning processes related to professional team coaching within a nursing team for the elderly be described and understood?	The student has conducted team coaching in two nursing teams. Followed up by interviews.	
Coaching as a tool for change – Observation of my own learning, as part of a professional management development process	1	How can I as a coach, inspired by the remembering conversations in narrative theory and on the basis of Niklas Luhmans idéologie frame a room for reflection that can help my client to gain increased insight and knowledge about what is hiding in a particular experience that has been seminal in her management practices.	The student has conducted one coaching conversation with a manager followed up by an interview.	Yes – student is a private consultant
Successful organizational change - How to combine bottom-line results with increased ability to create change?	2	Based on a concrete change project in organization XXX, we want to discuss dilemmas and opportunities in combining elements from theory E and O.	Action research project with a HR team in a large Danish company	Yes and No – One student is an employee in the organization the other is not.
From Expert to Novice - A metaphor for the transition from employee identity manager identity	1	Objective 1: To identify unique situations that indicates development of leadership identity. Objective 2: To investigate the relationship between the narrative inspired structure	Action research – Student conducting a leadership development program in her own organization.	yes

[2] See Table 1

[3] The 19 interviews were tape recorded and fully transcribed. Afterwards the interviews were read and scored for specific themes. 57 different themes were identified (½ 2). The average number of themes in each interview was 23. The analysis is divided into three parts: Before they started their education, during their educational years, and after they finished the education. The analysis is both deductive and inductive as it draws upon the theory of transfer but also seek to locate new information hidden in the data material.

		and methodology of the training course, and the participants' experience of leadership identity development.		
The inquiring hand	1	My didactic model, the inquiring hand, has its genesis in my teaching practice. In this thesis I will theoretically examine how my model can help to create an exciting and involving teaching environment. Furthermore I will test how the students respond to the model.	Experimental study. The student teaches two classes at elementary school with subsequent interviews with the class teacher who observed the teaching classes.	Yes – student is a private consultant working with school teachers
A locally based action research project at XXX school	2	How can concrete and perceived differences between employees at XXX school be trasnformed into collective learning thereby supporting the school's vision?	Action Research Project – working with the management team of the school as well the teaching staff.	Yes and No – One student is an employee in the organization the other is not.
Is it possible to turn on the lights? - A study on the possibility that leadership based coaching can initiate learning in the nurse's daily working life.	1	Can I through a deliberate change in my leadership practice increase the learning possibilities for nurses at my department?	Experimental study. The student imposes change in her way of conducting group meetings. She records these meetings on video followed up by interviews with 6 employees.	Yes
If coaching is the answer - What is the question?	2	How can the power relation between an employee and a manager conducing leadership based coaching be describer? And what kind of impact may the introduction of leadership based coaching have in the organization?	Video recordings of coaching conversations between a manager and an employee followed up by subsequent interviews.	Yes –The students are managers in the organizations in which the research is undertaken.
Manager selection I organization XXX	1	Is the choice of the managers to be promoted, based on future needs, or do the organization tend to choose a leadership profile that more or less reproduce the past? How is this selection process conducted in practice? And do the managers who make these decisions of promotion have the necessary competencies?	Observations from the student's own work as an HR consultant. Semi-structured interviews with four managers in the organization.	Yes
Transfer - from coaching conversation to organizational practice: Return on Investment.	1	What kind of learning takes place in coaching? How can the coach support this learning? How can the client transfer the insights from the coaching conversation into his or hers daily life?	4 coaching sessions with a manager. Followed up by a semi-structured interview. Team coaching of a group of social workers followed by a semi-structured interview of three employees.	No - The research project is about coaching managers and employees within social day care, but the student is

				actually employed at a school that educates social workers.
The appreciative sports club	1	Based on Axel Honneths theory of recognition, the thesis ask whether it is possible to develop an appreciative micro-culture in a traditional Danish sports club?	A focus group interview involving different members (coach, board member, etc.) of the sports club	No.
Project on the development of communication skills in an organizational context	1	How can LP-coordinators develop skills in relation to the LP model	Action Research involving a group of LP-coordinators from different schools	No, but the student works with the LP-model at her school.
How language-games frame a coherent continuity of care.	2	What characterizes the current cooperation across sectors in the psychiatric practice? Can leadership based coaching enhance cooperation between sectors in their efforts to establish and coordinate a coherent continuity of care for the mentally ill?	4 interviews – 2 in the municipal sector and two in the psychiatric sector.	Yes
Organizational learning - An analysis of the link between organizational learning and coaching	1	How can coaching improve organizational learning?	Theoretical thesis	No
Can a renewed concept for staff development interviews help develop the relational skills of the employees in XXX?	1	Can Otto Scharmer's Theory U constitute the foundation for manager facilitated staff development in the service industry through the renewal of the traditional staff development interviews?	Experimental design, with inspiration from action research.	Yes

Table 2 – Themes in interview

1.1 - Demands for new qualifications	2.1 - Relationship between education and work	3.1 - Learning and personal development
1.2 - Organizational involvement	2.2 - Theory-practice linkages	3.2 - Specific learning effects
1.3 - Personal development request	2.3 - Bridging the gap between education and work	3.3 - Bringing the education into practice
1.4 - Education as a fringe benefit and attempts of employee retention	2.4 - PBL activities	3.4 - Job change
1.5 - Manager involvement	2.5 - Organizational barriers for PBL	3.5 - Change of job function due to their own initiative
1.6 - Personal preparation prior to the program start	2.6 - The many hats	3.6 - What do the students manager know about the education

1.7 - Need to develop working skills	2.7 - Organizational commitment to the study process	3.7 - Colleagues' perception of change in students way of doing work
1.8 - Uncertainty about role and ability as student	2.8 - The pedagogy of the education helps bridge the gap between education and work	3.8 - What is the most important thing you learned?
1.9 - Education provides new career opportunities - CV optimization	2.9 - Specific and general transfer	3.9 - Continuing or ordinary education
1.10 - Experiencing strain due to lack of education	2.10 - Increased knowledge provides greater security and courage	3.10 - The learning diminishes with time
1.11 - Education as severance	2.11 - Transfer promoting factors at work	3.11 - To learn is a change in identity
1.12 - prioritization of the academic field	2.12 - Near transfer	3.12 - The title provides new opportunities
1.13 - Searching for a reflexive space	2.13 - Research oriented approach supports daily practice at work	3.13 - Improved skills at delegating
1.14 - The educational structure fits well into a working career	2.14 - Far transfer	3.14 - The academic perspective opens one's mindset
1.15 -Major life changes as a reason to start training	2.15 - Collaborating with other students on projects	3.15 - Uses training in daily work
1.16 - Education is required to move upwards in the organizational hierarchy	2.16 - Changing manager during the education obstructs PBL work	3.16 - Changing manager after the education reduces transfer
1.17 - Agreements on work / training time	2.17 - Serious / non-serious context	3.17 - Lack the support from the Master Program provided in relation to apply knowledge in practice
1.18 - Self payment	2.18 - Theory as opposed to practice	
1.19 -Education as part of recruitment agreement	2.19 - The education as a haven in a busy working life	
	2.20 - To combine work, education and personal life	
	2.21 - Changing job during the education	

WHAT KIND OF PROJECTS DO THE STUDENTS ENGAGE THEMSELVES WITH?

Each semester the students engage in problem based project work, the project being a self-defined intervention carried out in their own organization (Willert et al., 2011). Data documenting the interventions are brought together in the writing of a project report used in the assessment of the students. In this way the Master program seeks to produce a robust transfer of knowledge and competencies between the educational room and the organizational context of the workplace by forcing the students to apply their learning on real world problems in their organization and afterwards reflect upon the process from a theoretical standpoint.

As can be seen from Table 1, most students engage in problems that are part of their everyday working life, which they try to solve in new ways based on their academic learning. For example, one student who was a manager set out to develop new ways of conducting staff development interviews. Throughout the four semesters she experimented with different methodological approaches, transforming the organizational setup from a traditional way of doing things to a much more innovative and collaborative style, engaging her employees in designing structures to enhance and monitor their professional development. In this way the problem-oriented work promoted by the Master program fused with the daily work life of the

students. This may be why the majority of the students report that participating in PBL activities is learning enhancing. However, at the same time the introduction of PBL activities within continuing education poses some challenges for the students; therefore, we will touch upon two of these challenges: group work and the problem with opposing roles.

Even though the students praise the PBL work style, many report that group work is quite hard when combined with the stress of a normal working life. At the same time group work forces some of the students to conduct their project work in another organisation than their own. For some this can be liberating. They report that this helps them to set aside the more or less implicit demand concerning return on investment when initiating change project in their own organisation. In this respect they are free to focus on their own learning. While almost all the students recognize this feeling of "freedom-to-learn" some students report problems with making the proper connections between the project performed in another organisation and their daily work. The project becomes somewhat of a distraction, something you do when you are not doing what you are paid to do – your work. Perhaps this is one of the primary reasons why less than half of the students have chosen to work in groups on their final thesis[4]. Besides these problems some students report that doing project work in their co-students organisation makes the learning experience somewhat artificial. The interaction between classroom and workplace more or less vanishes, making the student feel more like traditional students in the ordinary educational system than employees engaged in continuing education.

It seems the "Aalborg PBL Model" poses some challenges for the students since group work at worst risks "widening" the gap between the educational room and the work space thereby decreasing the transfer process. On the other hand doing PBL work in your own organisation is not free of problems either. Even though the majority of the students prefer to carry out the project work in their own organization almost all students mention that the strategy induced challenges as well. The primary problem is too many different roles. Since the students hold positions as managers or consultants they are typically expected to uphold quite dominating roles at their workplace. Some report difficulties combining this position with the much less authoritative position as a student working to solve a problem in order to pass an exam. This dilemma can lead to questions such as "How will my employees react to me when I confront them as a "not-knowing" student. Another problem is that the students as managers are paid to increase the output of the organization. This may result in an unwillingness to engage in problems that are not guaranteed to succeed that can make the PBL work less challenging and inspiring.

As seen above PBL in continuing education poses some challenges for the students – challenges that are not found in ordinary university educations. Overall, it has to do with the question of which context (school or work place) should play the dominating role in

[4] The final thesis covers a self-imposed theme and the students are free to work in groups or by themselves.

continuing education. A theme we return to in our discussion. First we turn to another important topic in the transfer of learning discussion.

WHAT KIND OF LEARNING IS FOSTERED THROUGH STUDENTS PBL WORK?

All the respondents experienced difficulties when asked to describe exactly what they learned through their educational activities and how this learning enhanced their performance as leaders or consultants. Even though the students through project-based work, obtain an opportunity to enhance their working skills, it seems as though their learning is a complex process where development of ordinary working skills in many ways is intertwined with personal development. These two styles of learning become somewhat inseparable, which makes it hard for the students to talk about their learning without talking about their personal growth. When the students in the interviews were asked to describe what and how they had strived to transfer the knowledge acquired through their PBL activities they tended to refer to their learning as abstract, non-taught skills such as, greater patience with complex processes; enhanced willingness or courage to delegate tasks to employees; and increased ability to cope with complex and diffuse situations. Overall the interviews indicated that almost all of the respondents perceived their learning as inseparable from their ever-changing identity. A phrase from one of the interviews illustrates this point:

Respondent: It is because, when I look back on what I have been doing as a manager, but also upon my actions as the man that I am, the Master education has in some way infected all my daily activities. It is a part of me when I sit and negotiate with suppliers, or talk economics. It can be seen in my approach to leadership, in my efforts to motivate and manage people, in my ambition to try and understand what people think and believe, and to cope with the still increasing complexity of organisational life. It may well sound like a very huge thing, but actually it is just that it is part of me being a manager. It has become an integral part of me. Therefore I think you could say that I wear my education all the time.

The analysis of the interviews shows that it is quite difficult to spot evidence of direct knowledge transfer. Many of the interviewees report that the biggest changes provoked by the study activities are not a change of skills connected to their working life, but rather personal or dispositional developments, a development in the organisation of the self, which is to be considered as a side effect rather than an explicit and primary objective for the study program. When asked to mention transfer enhancing activities in the educational setup, many students suggest that the problem based project work has helped them to bridge the gap between an academic context and working life. Even so, it cannot be said that problem based project work is a flawless didactic tool for continuing education. Like any other pedagogical approach problem based project work has some limitations and challenges. In the Master program one

of the biggest challenge is to make the classroom and the work place converge, without one of them dominating the other. Other educational initiatives try to overcome the transfer problem caused by opposing context by moving the classroom out of school and into the production room. However, as we shall see in our second case this does not solve every single problem regarding transfer in continuing education.

FACILITATED WORK BASED LEARNING

The idea behind Facilitated Work Based Learning (FWBL) is to transform Problem Based method of educating students at Aalborg University into a practice-oriented method for continuing education of highly educated employees working in practise (Fink & Nørgaard, 2006; Thomassen, 2009). Two FWBL courses conducted in collaboration between two software engineering companies and AAU form the empirical foundation of this case. Two to four employees participated in each of the two cases. The duration of the FWBL course was approximately nine months and the engineers participating all had university degrees. The empirical data consists of 15 qualitative interviews conducted with employees, facilitators, project managers, and administrative staff from the university several times during the courses along with four tape recordings of meetings and learning activities (Thomassen, 2009)[5].

The objectives of FWBL are:

- To provide knowledge to busy employees within the industry without necessarily having to spend time on participation in traditional courses.
- To integrate knowledge directly and make it immediately applicable in the job functions of the employee.
- To plan tailor-made learning which matches the qualification needs of the company
- To apply the pedagogical model of Aalborg University – the problem based and project organised way of learning.
- To ensure that the course of learning as far as possible is related to a development project relevant to the company. (Nørgaard & Fink, 2004: 2)

The FWBL course is centred on work related problems that the employees find relevant and interesting. The FWBL course takes place in the company when the employees find it

[5] In the Ph.D.-thesis (Thomassen, 2009) the analysis of the empirical data was inspired by Giorgi´s (1992; 1994) phenomenological method of analysis. The 15 interviews and the four meetings were tape recorded and fully transcribed. The transcripts were read in order to get an overview and re-read in order to discriminate "meaning units" relating to the researched phenomenon. The analysis is divided into two parts. The first part contains four chapters due to the fact that four types of participants participate in the FWBL-courses. The analysis is inductive as it is based on "meaning units" and not due to predefined concepts or theories. In the second part of the analysis John Dewey´s pragmatic thinking was applied as the theoretical approach in order to gain further insight.

relevant, which requires a high level of flexibility within the FWBL structure. Hence, the idea is to offer a FWBL course designed and conducted according to the specific needs and requests of the participating employees.

A university teacher possessing extensive knowledge about PBL, and the subject dealt with during the FWBL course, is affiliated as facilitator. A high level of responsibility is placed on the shoulders of the facilitator both in regard to teaching and facilitator competences, but also in regard to flexibility, because the FWBL course follows the learning processes of the participants´ (Fink & Nørgaard, 2006). Hence, it is not possible to design and plan the FWBL course in detail on beforehand.

A profound disagreement concerning the relation between work and continuing education appeared during the analysis of the two cases. FWBL is based on the argument that continuing education and work related problem solving can be integrated, thereby transcending the distinction between work and continuing education, whereas the participants and the project managers perceived continuing education and work as two different types of activities. This difference created much frustration and many misunderstandings throughout the FWBL-courses, and a recurring question asked by the participants was "how can work and continuing education be integrated?" The reason why this question was asked time and time again can be traced back to another general tendency within the cases, namely the difference in objectives between the companies and the university. The companies were highly focused on problem solving which is exemplified by a quotation stemming from an interview with one of the project managers.

> (…) My need [as project manager] is, that my software developers understand a specific problem and that they can solve the problem (…) the university is more focused on the learning process, which I am not in this course, absolutely not. The objective is to acquire some basic knowledge. (Thomassen 2009:112)

The below quotation stemming from an interview with the administrative staff exemplifies the difference in objective as it is

> (…) not that they [the participants] have solved a concrete problem, the goal is that 2-30 engineers have learned to use a new software development method. (…) The objective is that they have learned something, which they can use is future development projects. (Thomassen, 2009:138)

In general the FWBL courses had difficulties in gaining a legitimate position in the companies which lead to FWBL being placed on the side-line after a short period of time: it was perceived as an activity of low importance. A number of reasons caused this to happen.

First, as the quote below exemplifies the companies' insisted that FWBL should provide their employees with skills that had direct and immediately correspondence to their work assignment, whereas the facilitators and the administrative staff perceived FWBL as the basis for some kind of meta-learning, helping the participants to comply with future tasks.
Second, from the companies' point of view the facilitator was not a person supporting learning processes, but a consultant knowing how to solve the problem. As one of the project managers explained:

> I expected that it was more than supervision because we received new knowledge from the outside via a person who knew the problems and worked within the area, so we expected more or less to receive the answer (…) I had expected to receive some clear statements saying "do this and do that," because based on experience this is what works. (Thomassen, 2009:114)

Third, because the problem solving processes in the companies changed very fast, the need for facilitation suddenly occurred. This made it difficult to obtain compliance between the participants´ work and the FWBL course, despite the objective of creating a flexible program. Hence, the employees were left to solve the problems on their own, making the facilitators seem useless.

> "(…) as when we get a problem and the project is running, then I have to solve it now. Then I cannot wait until next week or next week again, because maybe I must hand it in next week (…). In one way or the other I must find the answer to my problem". (Thomassen, 2009:102)

Fourth, the FWBL course was placed on the sideline because the participants expressed difficulties in understanding the idea behind FWBL. At the end of the course one of the participants stated, "I still do not really know what it is all about, and what would have been the right thing to do" (Thomassen, 2009:101).

All in all the cases exemplify that despite the good intensions of integrating work and continuing education via a PBL inspired method a number of difficulties occurred. It especially became apparent that what should have been the strength of the method, namely the close connection to practice, at the same time became the main problem. The logic and the objectives within the companies squeezed out the opportunity for learning as the time and space for reflection was only present to a limited extent.

PBL, TRANSFER, AND AUTHENTICITY

A recurring discussion within continuing education is how to establish a strong relation between practice and education in order to enhance the level of transfer. The cases outlined above are examples of two different didactical approaches to this problem.

Despite the fact, that the Master program and the FWBL program in many aspects are different they do have one very important aspect in common. Both approaches were founded on the argument that it is possible to create a strong pedagogical relation between work and education by letting students try to solve real life problems from their own practice. Hence, both approaches are based on a belief that in order to be *effective* continuing education must make the students working life an integral part of the educational activities.

A recurring discussion within continuing education is whether the educational activities should take place in a classroom or in the company. Fundamentally the discussion is about how the transfer distance between education and working practices can be reduced. Once again the two approaches have applied two different strategies. The Master program upholds the classic differentiation between education and workplace, but tries to shorten the gap by insisting on the students performing learning interventions in their own organization in order to be able to reflect upon these interventions in the educational context afterwards. On the other hand the FWBL program aims at minimizing the distance between the educational room and work context, by presenting the theory and methods in a workplace setting making a direct application of the theories and methods to the employees' work assignments.

Based on the fact that both approaches have real life problems as a core element one might expect transfer to be unproblematic; however, as outlined in the case descriptions this is not the case. In the first case (Master in Learning) there seems to be little doubt that the students have learned something, but it is difficult to find evidence about exactly which kind of learning has been transferred from the context of education to the work situation. In the second case (FWBL) the students have definitely not learned what they should have learned, according to the intentions of the educators. However, they might have succeeded in solving the actual task.

To further analyse the differences between intentions and actual learning outcomes in the two cases we need to reflect on the 'seriousness' of work and the "playful nature" of education. This distinction is the result of our reflections upon an important question raised by our analysis of the two cases: "What happens when problems, stemming from the students own organizational life, in some way becomes "too real" to provide them a proper context for learning processes?" In his article "*A theory of Play and Fantasy"* Gregory Bateson (1972) introduces the distinction between "serious" and "non-serious" contexts. In this article he puts forward that in participating in "playful activities" we refer to fragments of what we could

describe as "serious activities". Bateson proposes that we use these fragments as models for playing, perceived as a "non-serious activity", i.e., pieces of behaviour that imitates the forms of serious activities, but at the same time marks an important difference from these. A "nap" (play) is not the same as a "bite", and this distinction is an important one, but at the same time "the nap" entirely borrows its meaning from the real thing that is "the bite." Still the nap while simulation the bite at the same time communicates that we are not in a "biting context", that is "we are just playing". The relationship between the none-serious context (play) and the serious context is an important learning arena since it calls for a double transfer relationship: First, from the serious context to the game: Can we recognize the seriousness of the "play"? Play only makes sense if it is similar to and thus refer to the corresponding serious situation thus playing the game helps us understand the going around of "the real world". And secondly, from the game to the serious situation: play can often be seen as an exercise in preparation for seriousness. That is we can practice in a "safe" environment the skills we later need in "real life". An important point is that this practicing is only effective in that the participants in the "play" contextualize[6] this playing activity "as if" it was a serious situation – well aware that it is not. When these thoughts are translated into the context of education, it becomes clear that continuing education need to balance and find its way in the tension field between the educational room (as a playful or non-serious context) and working life (as a serious context). A maneuver with many built in challenges. To be effective educational activities must simulate the outside world, and the feedback that students receive would in some way be simulation of "real world feedback". But the students must be able to interpret this feedback as stemming from the playful context in order to be able to use it for learning purposes. We see that in fact the educational practitioners is in the "napping business" and not the "biting".

Bateson's distinction between serious and none-serious situations is important as it clarifies some of the qualities of an educational setting. The none-serious educational context can in some ways set the fantasy and inspiration of the participants free, as the setting is perceived as a safe and therefore a pleasant and motivational enhancing learning environment. At the same time every educational activity must balance in the space between serious and none-serious activity. Simulating the real world without being perceived as an altogether none-serious activity[7] since it is this "as if" quality that makes the transfer of learning occur.

In the FWBL case the project manager clearly focuses on problem solving in a very exact and pragmatic sense. In order to make the operations effective it is crucial, as he puts it, that "my

[6] The term "contextualize" can be described as a subjective classification of the context. The context is in this text understood as our surroundings - in other words, our environment (an all-encompassing understanding of the context concept, which Keiding & Laursen (2005) has criticized for lacking analytical power because of the conceptual over inclusion). Contextualization is in this respect, the active process of people ascribing subjective meaning to certain stimuli or artifacts thereby reducing the context infinite potential of meaning.

[7] A problem seen in many team building activities (in Denmark known as the so called "rabbit killing courses") in which we see that the context and the conditions of learning varies in such profound ways from the organizational activities the course aim to enhance, that learning transfer seems at best to be very limited.

software developers understand the problem", that is, understands it as the manager does, and then again as quickly as possible develops the same understanding of the problem. This is work as a serious matter. However, from an educational PBL standpoint, it is important that the students spend much time and effort on trying to define the problem in question, "playing" with different ways of seeing and understanding it. This might also be a good idea in a strictly working life context, often resulting in brilliant and most effective ways of solving the practical problem, - but the *time pressure*, so crucial for this context, does not allow this playful approach.

In the Master education case the problem and project was related to broader, developmental tasks (making a certain organizational change happen over time) which often gave place to experimentation. "Giving place" here refers to two important aspects: *time* and the *consequences of making mistakes*. If the consequences of making mistakes, working with "serious" working life problems in an educational context is grave or even fatale, and if the time pressure does not allow reflections on possible alternative ways of understanding the problem and seeing the world, as well as an on-going reflection on the steps of action as the project unfolds, then the 'seriousness' of the authentic problem run the risk of becoming too overwhelming for the students, in order to succeed on the learning tasks. One the other hand some students complained that the Master program was uninterested in the seriousness of their working life in that the educators stressed that good academic projects does not equal successful projects. These students felt that the education did not respect the opposing serious logic of the workplace forcing them to choose between logics removing meaning from their study activities: "We only do this because the education tells us to, not because there is an organizational need for our intervention".

CONTINUING EDUCATION PLACED BETWEEN OPPOSING LOGICS

In the previous section we made a distinction between the 'serious' nature of work, compared to the 'playfulness' of education. Both cases provide good examples of, what we in reference to the PBL model have called, "solution orientated" problems; likewise, both deal with 'real problems' of the work sphere, while at the same time the two programs hold quite different positions on the playfulness-seriousness dimension. This is due to the fact that it is possible to find both zones of playfulness as well as zones of seriousness *inside* the work sphere. As pointed out by Argyris (1992) and Ellström (2002) there are two different spheres dominated by two different types of logic included in the context of work. (Laursen, 2011; Willert et al., 2011; Helms Jørgensen, 2008). In one sphere, mistakes are allowed, or at least not considered to be fatale in their consequences. Time pressure is not the all-encompassing issue, and doubts, risk taking, conflicts and experimentations are as such allowed. This is the context of *developmental learning* (Ellström, 2002). In the other sphere it is important to acquire a high level of efficiency, which means that the decisions must be taken and carried out in a context

of strong, mutual understanding of how to perceive and define the situation and the related problems. This is the context of *reproductive learning*

Zones of reproductive learning are 'serious' due to the fact that it is usually fatal to make (too many) mistakes in this context. While in zones of developmental learning this 'reality principle' is to some degree suspended, for a shorter or longer period of time. In this perspective the concept of 'play' is quite accurate when trying to describe important qualities of zones of developmental learning. Still, it is important to remember that the primary objective of developmental activities is the solution of real work related problems, and that these activities are exposed to the same kind of pressures and intimidations as seen in the FWBL case. With this in mind, it seems evident that the 'solution orientated', 'real life' problems of the two cases refer to two different spheres and logics. In doing so, the FWBL case presents the construction of a conflict between the reflective nature – as well as the playfulness of education confronting the logic of reproductive learning, where doubts and playful imaginary reflections are reduced to a minimum. In the Master program, the problems and tasks of the students refer to the sphere of developmental learning, which is more in harmony with the learning logic of education. At the same time it might be hard to define what the exact result of developmental learning processes might be and how the students benefit from these learning processes in their professional lives.

Quite often companies tend to ignore the perspective and importance of developmental learning, while educational systems often tend to ignore the importance of reproductive learning, especially in continuing education. (O'Reilly & Tushman, 2008; Aylward et al., 2003). The ambition to integrate the students' working life in the educational activities can be seen as a way of trying to manage this field of tension between logics. But, as we have noticed earlier, the activities of 'play' are often redefined as 'serious business'. The 'nap' is so easily transformed to a 'bite', and due to this transformation, the learning outcomes are heavily reduced. The two studies demonstrate how difficult it is to combine the two opposing logics in one integrated process of educational intervention. In the FWBL program the logic of reproductive learning dominates throughout the entire project, leaving no room for learning and more experimental developmental learning. In the Master program the boundaries between contexts are much clearer making the learning situation easier for the student to understand as a context for self-directed action; however, as we have seen this comes at the price of transfer reduction.

DIDACTIC PRINCIPLES FOR ACADEMIC CONTINUING EDUCATION

In this article we have tried to answer the question: can PBL be a way to enhance the learning transfer in continuing education? As this article has shown the implementation of PBL based teaching models brings no guarantee for transfer of training. In our opinion the ambition of bringing academic educations into working life through problem solving activities is

sympathetic in its intentions as well as promising on a more practical level since continuing education (inside or outside the university) focusing entirely on general transfer is bound to run into trouble (Baldwin & Ford, 1988; Aguinis & Kraiger, 2010). Still the foundation of the university is and has always been complex and abstract or generalized knowledge. In our opinion universities should not try to simulate or copy the teaching done by other more practical oriented institutions. Universities need to focus on their own strength! At the same time they cannot run the risk of becoming irrelevant in the eyes of the labour market. Therefore, they need to find ways in which their expertise – abstract and complex knowledge – can be used in educational contexts aiming at developmental orientated learning processes as well as more reproductive oriented ones. This leads us to the following concluding points regarding PBL as a transfer enhancing strategy in continuing education:

1. If the universities attempt to embrace the logic of the productive system they risk losing focus on what the university does best thereby ending up teaching something which the university knows very little about: production in an organizational context. This is not the same as saying that continuing education in an academic context should ignore praxis. Instead we must continue to strive to find ways in which praxis and the class room can enrich one another. Therefore, we propose that in order to conduct successful and effective continuing education the academic paradigm should play an integral part in every university driven PBL project. Respecting the logic of the organizational system is not in opposition to insisting on promoting academic knowledge as a valuable educational asset.

2. When making "real problems from the working life" the point of departure for the use of PBL in continuing education, it is crucial that a distinction is made between reproductive- and developmental learning contexts, as they demand different qualities of the university system. The university system often has quite a lot to offer to both types of context and also to the reproductive orientated learning processes, but naturally the knowledge of 'experienced professionals' here will often be more substantial than the knowledge of the average university teacher, and the teaching programs should be outlined in respect of this fact.

3. In PBL organized, continuing education it is important that the *time structure* of the educational process shows a reasonable match with the time structure of the relevant working processes. Educational projects with lots of time to reflect, read books and discuss the problem at hand might serve as excellent frames for 'developmental learning'; however, often they ought to be combined with processes where the students are trained to use the acquired competencies in the context of a more realistic time structure. As we noticed in the FWBL case a lot of 'real working life problems' simply does not fit as a context for university teaching, because the time pressure does not allow more analytical reflections.

4. When *projects* following the Aalborg PBL Model are carried out as 'real life experiments' trying to handle 'real life problems', as we have seen in the two cases, it is important that they make room for experiments, fantasy, reflections and mistakes. On the other hand, the 'playfulness' of the developmental learning must not lead to a situation where the students consider the projects as pure "virtual games" (Kaplan & Haenlean, 2009). To avoid this, it is necessary to introduce a proper quality of realism or 'authenticity' in the educational project. That is: the products and the working processes ought to resemble 'business as usual' for the area in question. Academic PBL activities in continuing education should be structured in a way to make a greater rate of comparability between the character of the PBL projects and the kind of activities which students' are to engage in, during their professional lives. And finally, the projects ought to have some kind of 'real consequences' in working life.

CONCLUSION

In this article we have presented the Aalborg PBL model that is the pedagogical basis for all educations at Aalborg University. This includes our expanding activities within continuing education. We have presented two research projects that in different ways illustrate the possibilities and problems with problem based project work. In both cases the basis for the educational activities are students engaged in working with 'real life' problems in their own organization, but in both cases we see that the PBL activities wind up in a struggle of authority between the seriousness of the working condition and the playfulness of the educational context limiting the students possibility of transferring knowledge from education to work life. This leads us to propose several statements about PBL in academic continuing education. Further research should validate these propositions by testing their use in action in order to show that continuing education resting on these propositions in fact is transfer enhancing.

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The Interpretation of Problem Based Learning: A Case Study

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ABSTRACT

Currently, there are a large number of higher education institutions transforming their traditional educational approaches to PBL. In order to address the challenges for PBL implementation for a university, it is quite necessary to investigate how the managers and staff members interpret PBL in practice. Through the exploration of a university which is in the process of transforming its traditional educational paradigm to PBL, we note that there is a lack of unified understanding of what PBL is at the university. Several different PBL interpretations emerge and some of them are quite inconsistent with, or even contradictory to each other, which further pose significant challenges to the university when implementing PBL. It should be acknowledged that the diversification of PBL interpretation is unlikely to avoid at a university. The diversity of PBL interpretation would create large tensions at a university, but it also points out new possibilities for the university.

INTRODUCTION

Since the inception of the late 1960s, the PBL (Problem Based Learning) approach has a history of over four decades. Gradually, the value of PBL has been recognized and documented in a number of researches (e.g. Dolmans and Schmidt, 1996; Dochy, Segers, Bossche, and Gijbels, 2000; Bowe, and Cowan, 2004; Strobel and van Barneveld, 2009). PBL seems to surpass traditional education approaches in terms of promoting students' skill development (e.g. communication skills, problem solving skills, critical thinking), motivating students to learn, as well as fostering students' lifelong learning attitude, etc. Therefore, PBL has been adopted by an increasing number of higher education institutions worldwide. As the effectiveness of PBL has been widely recognized and documented, Strobel and Barneveld

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(2009) suggest that the focus of the researches regarding PBL should be shifted towards the challenges of PBL implementation, which implies that the research field is to some extent lacking the knowledge regarding the challenges for PBL implementation. Likewise, Savin-Baden (2000) notes that current PBL researches are primarily concerned with providing guidance in and examples of PBL implementation and they are thus paying little attention to dealing with the difficulties and complexities of PBL implementation.

The challenges for PBL implementation has been documented in some studies (e.g. Little and Sauer, 1997; de Graaff & Cowdroy, 1997; Lonka, 2001; Ward & Lee, 2002; Tai, Huang, Bian et al., 2008; Kolmos, 2008), and it is noted that various factors could be responsible for hampering PBL implementation, such as resource limitation, influence of tradition, inappropriate change strategy, etc. Among these factors staff opposition against PBL has been recognized as detrimental for PBL implementation (de Graaff & Cowdroy, 1997; Lonka, 2001; Kolmos, 2008). In general, resistance against PBL is viewed as a result of the conflict between traditional educational paradigm (such as lectured based learning) and PBL. The argument could be put in this way: since teachers are quite accustomed to traditional way of giving students lectures, they tend to doubt the value of PBL and become quite reluctant to participate in PBL activities. However, this is only part of the story.

Apart from the conflict between traditional educational thoughts and PBL, it is equally worth noting that educational theorists and practitioners' fragmented understandings of PBL also bring challenges for PBL implementation. By fragmented, we are arguing that since there is a lack of consensus on the definition of PBL, the interpretations and the uses of PBL in practice are quite diverse (Barrow, 1986; Savin-Baden & Major, 2004; Moesby, 2004). In several cases, different understandings of PBL are significantly inconsistent with, or even contradicted to each other. Though PBL theorists have relatively reached the agreement that different PBL interpretations could lead to different PBL approaches addressing different educational needs, the diversity of PBL interpretation as well as its implication for a university in practice has not received sufficient research attention. Therefore, the research question in this study is formulated as: What will happen if there are several different or even inconsistent interpretations of PBL in a single higher education institution, and how should we understand this phenomenon?

In order to address this question, we are primarily concerned with how managers and staff members interpret PBL in higher education institutions. The intention of including the conceptions of managers and staff members in this article is basically due to that, firstly, in general, the conceptions of organizational members produce a significant impact on organizational process (Henriksen, et al., 2004). Regarding education and PBL, teachers' conceptions of teaching and learning determine which instructional approaches they are going to employ (Trigwell and Prosser, 1996; Trigwell, Prosser and Waterhouse, 1999). For example, teachers are more likely to maintain the use of lecture if they think that learning is to

obtain knowledge content from external authorities, whereas they are more willing to encourage students to engage in learning activities if they hold that learning is a process in which students construct their own knowledge. Further, although the definitions and designs of PBL has been widely addressed in literature (e.g. Barrows and Tamblyn, 1980; Boud, 1985; de Graaff and Kolmos, 2003), on the whole, the voices of staff members are largely missing from the studies on PBL (Savin-Baden, 2000, p.9), which further implies that little has been studied on the conceptions of staff members regarding PBL. Therefore, it is quite necessary to explore how staff members interprete PBL in practice during the PBL implementation process.

We will start with a brief review of what PBL is. It could be found that in general, the consensus on the understanding of PBL has been reached yet. Afterwards, the empirical part is largely replied upon a university which is in the process of implementing PBL. Particularly, the focus will be concentrated on how the managers, the staff members, and other actors at the university interpret PBL in practice. Further, we will explore the impacts of the diversity of PBL interpretation on PBL implementation at the university, and how we should understand the phenomenon of the existence of different PBL interpretations at a university.

THE UNDERSTANDING OF PBL

There are a large number of definitions and principles of PBL. Barrows and Tamblyn (1980) identify five characteristics of PBL: complex and real world situations, teamwork, students gaining new information through self-directed learning, teachers' role as facilitator and problems leading to clinical capacity development. Walton and Matthews (1989) propose that PBL could be recognized from three dimensions: firstly, there are some essential characteristics which distinguish PBL from other educational approaches, such as that curricula are organized around problems rather than disciplines, an integrated curriculum and an emphasis on cognitive skills; secondly, some conditions such as small groups, tutorial instruction and active learning should be established so as to facilitate PBL learning; thirdly, PBL should produce some special learning outcomes in terms of skills, motivations, as well as the abilities to become lifelong learners. Kolmos (2008) categorizes three major dimensions of PBL: learning perspective in terms of problem based learning, content perspective in terms of inter-disciplinary learning, as well as social learning such as group work. Although these researchers agree on some general PBL principles, such as problem centered, teamwork, they did not fully reach a consensus on what elements PBL should contain.

In practice, various uses of PBL are developed in order to address different educational objectives. We may see these examples in the works such as Barrow's (1986) PBL taxonomy, Savin-Baden and Major's curriculum model (2004, p.35-45), Moesby's PBL approach (2004). They exemplify different uses of PBL in practice, which further points to different PBL interpretations with different assumptions of educational objectives and learning. For

example, when PBL is implemented at the individual level, only a small proportion of the learning material in a single course is delivered in PBL. In this sense, although there are some PBL elements in a course, the whole curriculum is still lecture based. Another example is, the curriculum may have a common large project to make connections between different subjects; however, whether the curriculum is based on PBL is largely dependent on whether curriculum design starts from a problem (Moesby, 2004). In other words, the existence of a common large project does not necessarily mean that the curriculum is quite PBL based. These PBL approaches, although all termed as PBL and having some PBL elements, are not quite consistent with each other. Some of them may even be contradictory to each other. For example, a curriculum system, which contains a common PBL project coordinating different subjects, can either be problem based or lecture based.

Further, it is discussed whether PBL should be seen as an instructional approach (e.g. Savery and Duffy, 1994), or an educational philosophy (e.g. Margetson, 1991). In practice, when PBL is only seen as an instructional method in an educational institution, the entire organizational culture still sticks to its traditional values and no change happens to educational objectives and assessment methods. In some cases, PBL may even serve as means to promote students' knowledge retention. On the contrary, when PBL is treated as a general educational philosophy in an educational institution, PBL may be seen as "*a conception of knowledge, understanding, and education profoundly different from the more usual conception underlying subject-based learning*" (Margetson, 1991, p.43). The educational objective, the teaching and learning method, the assessment method, the design of the curricula and the courses, the organizational system as well as the organizational culture are restructured as a whole in accordance with the value of PBL.

From the above discussion, it can be noticed that the interpretation of PBL is quite diverse. As for current PBL studies, researchers have already noted the value of these different PBL understandings for curriculum design which could address different educational needs. However, they have not paid sufficient attention to the implication of these understandings for a higher education institution which is in the process of transform its traditional educational approach to PBL. In the following section, we will see that the existence of different interpretations of PBL in a single university produce significant impact on the process of PBL implementation.

METHOD

In order to address what will happen if there are several different PBL interpretations in a single university, this article is particularly concerned with university X in Australia which in recently years made initiatives to transform its traditional educational paradigm to PBL. Case study (Yin, 1994; Flyvbjerg, 2006) is chosen as our research method because it allows an in-depth exploration of a particular organizational phenomenon which, in this study, mainly

refers to how PBL is implemented at the university and how PBL is interpreted by managers, staff members, and other actors who involve in PBL implementation. The empirical data includes 16 in-depth interviews (managers, research and teaching staff, technical staff, external consultant), internal documents from the university (such as policy statement and curriculum plan), and staff's publications regarding PBL implementation.

A BRIEF STORY OF PBL IMPLEMENTATION AT UNIVERSITY X

Since 2005, the top manager at university X initiated a change plan to introduce PBL into two of its engineering programs: School of Electric and Electronic Engineering (EE), and School of Architecture, Civil and Mechanical Engineering (ACME). They transformed their curriculum in different manners, and eventually formulated two different PBL approaches. The program of ACME (see figure 1) consisted of four units: Physics, Math, Experimentation and Computing, and Engineering Profession. For each unit, a particular component was delivered in the form of PBL (e.g. a project), serving as a complementary entity for the subject. On the whole, a total amount of half of the course content was delivered in a PBL approach (Mills and Treagust, 2003). EE introduced a holistic approach (see figure 2), which led to a radical change, involving the process of redesigning the whole curriculum system. Prior to the change, the EE program had four segmented subjects: Math, Physics, Circuit Theory and Electronics, and Computer Engineering. All of them were focusing on knowledge acquisition. After the redesign process, these four subjects were restructured into two subjects: Electrical Fundamentals, and Enabling Science. They remained lectured based, aiming to offer students fundamental knowledge of engineering and scaffolding the project unit. PBL and Engineering Practice was newly developed as the PBL component, embodying in the form of a big common project coordinating four subjects, allowing students to work on a common project in groups, draw the knowledge from the lectures to solve the problem, and connect what they learned in the lecture to real problems and practical situations. The ratio of subject units to PBL component was 1:1. In addition, the university established a new way to assess students' learning outcome, rather than just evaluating students merely by a final individual written exam. This included the portfolio, project evaluation, group report and presentation, and individual performance. Meanwhile, in order to create an appropriate and comfortable learning environment, the university invested a large amount of financial resource in improving its basic infrastructure, such as building PBL studios and group rooms, providing facilities, as well as offering new equipment.

In 2008, the two schools merged together as the School of Engineering and Science. After the organizational restructuring, the new school decided to replace two distinct PBL approaches with a common PBL model. In 2010, the common PBL model was introduced to replace the two separate education models (see figure 3).

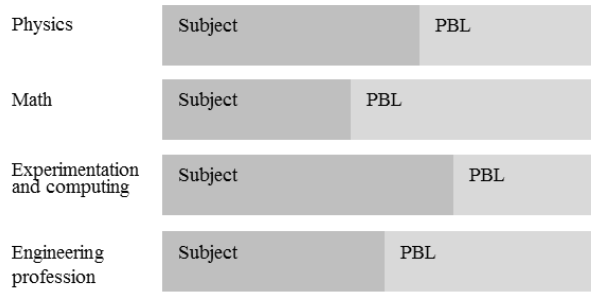
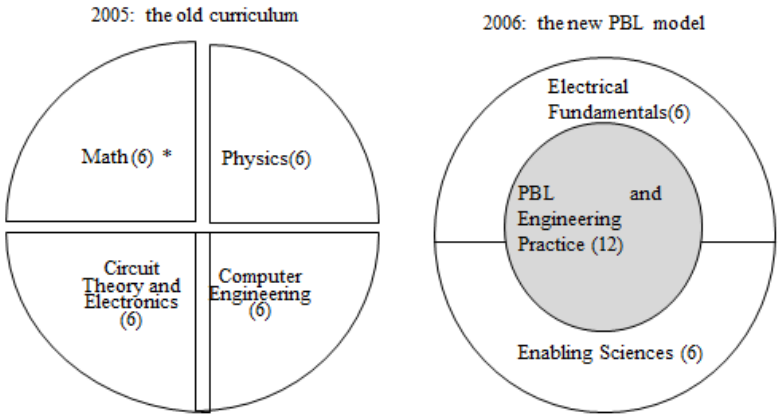


Figure 1: ACME PBL model



* indicates the number of the credit points

Figure 2: EE PBL for the first year program

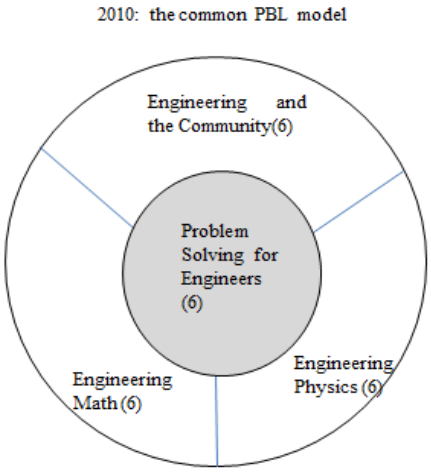


Figure 3: The common PBL model in 2010

DIFFERENT PBL INTERPRETATIONS

Based upon our empirical work, we notice that a diversity of PBL interpretation has emerged. At the systematic level, EE and ACME implemented different PBL approaches; at the

individual level, some staff members may agree with either EE PBL or ACME approach, while other staff members have their own conceptions of PBL which are inconsistent with both EE PBL and ACME PBL approach. They could be further specified as following:

THE 1ST INTERPRETATION OF PBL: EE PBL

EE staff referred to PBL as a curriculum approach which consisted of several traditional subjects, which were aimed at presenting the fundamental knowledge to students, and a common project unit, which was utilized to coordinate and making connection among the subjects. It could be regarded as a holistic curriculum approach as it coordinated different subjects through working on a common project. As a systematic approach, the assessment method was also adjusted in accordance with the learning objectives. According to many managers and staff members, this approach could be recognized as a high quality PBL approach since it shows great strength in cognitive value. Since a large project is designed to coordinate different subjects, therefore it could assist students to break traditional disciplinary boundaries and recognize the connection between different disciplines by encouraging students to draw on theories and methods from different subjects to work on the project. In this sense, interdisciplinary learning is largely manifested. Further, it is also beneficial to coordinate the behaviors of the staff by designing a systematic educational schedule and encouraging teamwork among staff members. The recognition of the value of EE PBL may explain that when the School of Engineering and Science decided to implement a common PBL model to replace both EE PBL and ACME approach in 2008, EE PBL became a prototype (although with some revision) to design the new PBL model.

THE 2ND INTERPRETATION OF PBL: ACME PBL

ACME PBL referred to a PBL approach which was composed of four PBL subjects, each of which consisting of a lecture component and a project unit. The project component was only aiming at coordinating the knowledge content in one course. Some staff members argued that ACME PBL was more suited for ACME program where there was a "*strong individual culture*". In this sense, a radical change was more likely to cause large tensions in ACME program, since such a change would large interrupt staff members' schedule and thus led to their resistance. Therefore, a gentle change, which allowed staff members to experiment PBL in their own course, seemed more feasible to reduce staff's opposition if the university wished to see a "*smooth*" change.

However, many staff members maintained that ACME PBL was flawed since first, from a cognitive sense, it was single discipline based and it failed to assist students to recognize the relationship between different disciplines and thus the principle of interdisciplinary learning was not well addressed (as an external consultant commented); second, there was lack of coordination between different staff members, as one technical staff member commented,

"*PBL requires students to work in a group, but we staff members do not work as a team.*" ACME PBL approach seems weaker in formulating a coherent schedule to coordinate the staff, since each staff member is only responsible for designing his/her own course schedule and thus need not to considerate what other staff members are doing. In some occasions, the lack of coordination may cause that sometimes, students are overwhelmed by huge academic burden when several projects are bumping together, while at other times, students may have no PBL work at all.

THE 3RD INTERPRETATION OF PBL: COMMON PBL MODEL

The Common PBL model was a result of the organizational restructuring between EE and ACME. It could be viewed as a new version of EE PBL model since there were a lot of commonalities between them. The new model continued to use large projects to coordinate different subjects. However, one major difference of the new model from EE PBL model was that the new PBL consolidated and strengthened the status of lecture based learning in the curriculum system. The proportion of the subjects increases from 25 percent in EE PBL to 50 percent in the new model. The fundamental impetus to increase the proportion of lecture was to highlight the importance of the acquisition of the basic knowledge content. The argument for the reduction of PBL proportion was that, since many students were lacking PBL experience before entering university, they needed more time to get adapted to PBL environment.

THE 4TH INTERPRETATION OF PBL: MEDICAL PBL

Some staff members, due to their own working experience, regarded PBL as synonymous to the one that was widely used in the medical field where students worked together on a medical case. A senior staff member who had accumulated many years' experience of staff training, recalled that,

> "I worked in medical field before I came here. That was where I introduced PBL. But I chose to use PBL when I was teaching. … That was a PBL that was based on 2 week cycle. I present to them with typical higher education, tertiary education, teaching problem. And we met face to face in groups, facilitating groups, so it is more like the medical PBL in Aalborg, project based, identifying basic issues, and allocating tasks in the first meeting. And we did not meet again for two weeks, and they located the resources and post them on the website coming on to them. And then we came back together. We spend the first half of the meeting, pulling over that together, finishing that problem, and start next one. That was much more like a medical type of PBL with relatively short cycle."

The staff member tended to link PBL to medical PBL approach (Barrow, 1986) where students worked on a medical case in the form of groups. Indeed, PBL originated from the medical field and the medical PBL has so far become one of the most representative PBL models in PBL domain. Nevertheless, the managers at university X, though agreeing upon the notion of PBL within the medical field, emphasized that there was a distinct difference between the medical PBL and the engineering PBL,

> "Other schools (at this university) don't have PBL in the same way as an engineer does. The nurse works very much on case studies, in a very highly simulated environment. So we have very high technology, digital human being that has blood and blood pressure. So they do some of their work there, and they do other work in clinical settings. For nurses they have to do about 900 hours in hospital and community based setting, as well as simulated learning activities… You might say that that is problem based learning as well. But when you come to talk to us about problem based learning, we are going to focus on the engineering because we say that it is a whole curriculum approach."

The managers tended to view medical PBL as simulated learning activities and work in hospital. From the viewpoint of the managers, the medical PBL, though having been justified in the medical domain, could not be used as an official PBL at engineering programs at university X, where PBL was solely referring to an engineering PBL approach.

THE 5TH INTERPRETATION OF PBL: PBL AS PROBLEM SOLVING LEARNING

Some staff members regarded PBL as a general cognitive process, which was pervasive in the educational domain. In this regard, PBL was not special but serves as a basic feature of education. A senior staff member who had worked in industry for years argued,

> "(University X) was for a further long time involved in, perhaps many other universities, were involved in delivering part of the content through PBL. Of course it is not called PBL. You cannot teach engineering without bringing in problems from the outside. I think the same applies to law, to accountancy, to marketing…"

Another young staff member with an art background reached a similar but complementary argument,

> "When I did my degree, because I did an art degree, we did problem based learning in art, which was that you were given a problem or a project, then you were going to work on it, so PBL has been taught in arts for a very long time. Like drawing a chair…"

They regarded PBL as being prevalent in educational settings since learning always involved dealing with problems. Whether it is an industrial problem, or an artistic one, they all shared

the similarity of dealing with problems. As long as the learning process involved a problem, it could be called as PBL. However, a senior staff member, though acknowledging many engineers' experiences in problem solving, refuted their attempts to transplant their industrial experience to the university setting, thus making PBL equivalent to problem solving in industry,

> "Engineers, they know about problems, I think they know about problem solving, when you talk about problem based learning or project based learning, they think it as the same as problem solving. So they think that if you give a series of lectures or something, then you get the students to apply to a problem, that is, problem based learning. So we have lots of arguments, but one of the key characteristics of problem based learning is that it starts with a problem."

From this quotation it can be noted that the key trait distinguishing PBL from industrial problem solving was that PBL set the problem as the departure for learning whereas the industrial setting viewed the problem as an area to examine the already-acquired knowledge. The managers viewed PBL as a particular kind of curriculum approach in which curriculum design and learning process should start with a problem.

If we refer to literature, whether problem solving learning and PBL could be regarded as synonymous is still controversial and confusing (Savin-Baden, 2003). Savin-Baden (2003) insists that although they both involve dealing with problems, problem solving in the industry cannot readily be regarded as being synonymous to PBL since it only involves the elements of problem solving, that is, the application of knowledge to a specific problem setting. The focal point of problem solving learning is the acquisition of knowledge rather than the learning process. The knowledge within problem solving learning environment is always given beforehand, and problem solving components only serves as a means to facilitate and test the students' understanding of knowledge from the lecture. However, PBL requires that problems should serve as the learning departure and then dominate the whole learning process. The knowledge acquisition progresses as students deal with the problem.

THE 6TH INTERPRETATION OF PBL: PBL AS MANAGERIAL BEHAVIOR

Mostly, PBL was addressed by staff members as an educational matter at university X. However, some staff members tended to interpret PBL as a managerial attempt. Although PBL was officially introduced into the university for the first time, it was not totally alien to some staff members working at the university. For example, for the staff members who equated PBL to problem solving learning, they tended to think that they were already implementing PBL since they believed problem solving learning to be a certain form of PBL. For these staff members who had their own thoughts of and experience with PBL, the official

PBL became a managerial practice to normalize their own behavior. As a senior staff member commented,

> "(This university) was for a further long time involved in, perhaps many other universities, were involved in delivering part of the content through PBL. Of course it is not called PBL. …I guess what happened two years ago was that the university wanted to formalize this and make sure that we do it correctly."

It can be inferred from the quotation that PBL implementation at the university was not about introducing something new; rather, it was a matter of managerial intention to ensure the correctness of organizational behavior. In this process, the old practice of PBL, which was not consistent with the managerial interpretation, would be corrected, replaced, or even eliminated, which implies further tensions in the organization.

To sum up, there are many different PBL interpretations in university X. The first three PBL interpretations are associated with the *managerial intention* since they are the officially defined PBL and they often determine how PBL will be implemented throughout the entire organization. The other three interpretations can be termed as i*ndividual interpretations* of PBL since they refer to how the individual staff member understands PBL in practice. Although there is quite little systematic record of the individual interpretation of PBL in the previous literature, the individual understanding of PBL is crucial for PBL implementation, since it is the individual who translate PBL into real practice and execute actual impact on the student.

These PBL interpretations are not always consistent with each other; rather, they are differing from each other in their perceptions of educational objectives, how to organize PBL curriculum, and how to conduct PBL with the confined amount of resources. The managerial interpretations of PBL have not reached an agreement on the size of the problem and how to coordinate different subjects. For example, ACME program tends to use several isolated subjects, each of which containing a certain amount of PBL elements, whereas EE staff favor to use a large common project to coordinate different subjects. Some individual staff members may agree with a particular kind of managerial intention, while other others hold their own perceptions of PBL, inconsistent with neither of the managerial interpretations. For example, the staff members, who equate problem solving learning to PBL, tend to insist that PBL is not something new or special but a general cognitive process already prevailing in educational field. Following this, they further maintain that the university is already carrying out PBL activities even prior to the introduction of PBL and therefore the introduction of PBL is more like a managerial action rather than an educational matter.

HOW DO WE UNDERSTAND THE DIVERSITY OF PBL INTERPRETATIONS?

What are the consequences of the diversity of PBL interpretations?

As there is a diversity of PBL interpretations at university X, given our research question, it is necessary to address the impact of the diversity of PBL interpretations on PBL implementation at the university. As noted above, since the manager of the university was implementing a holistic PBL approach throughout the university, the diversity of the interpretations of PBL was likely to produce large tensions between the staff members who held the same PBL conception as the management level did, and the staff members who stuck to traditional educational approach, or had their own thoughts about what PBL was, which was not consistent with the managerial attempts. Many staff noted the ongoing pedagogical debate on the value of PBL, which fractured the staff's attitude towards PBL implementation. Some staff members remained doubted about the knowledge coverage of PBL and they insisted that PBL was unable to guarantee that students could learn sufficient knowledge content, and therefore PBL would be detrimental to students' future development. On the contrary, PBL proponents challenged this argument and maintained that PBL was not about teaching detail but to foster students' skill development.

Apart from the pedagogical debates between the staff supporting traditional educational approach, and PBL proponents, the diversity of PBL interpretations added to complexity of tensions at the university, since the staff members hold quite different values about PBL even if they claimed to advocate the same term. For example, the staff members who supported ACME PBL preferred a course level PBL since they thought it fitted the disciplinary context of ACME. However, from the viewpoints of EE PBL proponents, ACME PBL was flawed in at least two aspects: firstly, ACME PBL failed to coordinate different subjects, since each individual teacher was only concerned with his/her own subject and failed to pay attention to the connection between his/her own subject and other subjects. Further, ACME was likely to create huge academic burden for the students when several staff members implemented PBL in their own courses simultaneously.

Moreover, the tensions can be noticed in practice. In decision making process, it was quite challenge to make all staff members accept the idea of PBL. Eventually, as commented by a senior staff member, staff members were somehow forced to do so due to the pressure from the management level. Even so, a considerable number of teachers were quite reluctant to participate in the staff development programs regarding PBL. As noticed by some staff members, some teachers "*rarely show up in staff training programs*" and they tended to find all kinds of excuses for not participating in PBL related activities. They might be involved in teaching, or other activities and they seemed to be not having time to engage in PBL training. Further, many staff members were sticking to the traditional way of teaching regardless of PBL implementation. Some staff members even ran extracurricular lectures so as to secure the knowledge coverage for students even if they were not getting paid for it. Tensions between

EE and ACME PBL proponents can easily be noted. When EE and ACME PBL approaches were running in parallel, they were not clash with each other. However, when the university decided to abolish ACME PBL approach and transformed it to common PBL model, tensions between ACME PBL advocators and common PBL model proponents became quite significant. As a senior staff member recalled, it was quite difficult to convince the ACME staff to accept the use of large project,

> "We had series of weekly meetings at least with course coordinators… to work a way through this…it takes months and months and months of negotiation,… finally they accepted, but still it was imposed really against the will of the coordinator."

As for the staff members who had their own thoughts of PBL, although they claimed to support the idea of PBL, they were more likely to retain their own conceptions of PBL, such as problem solving learning, which were not consistent with the managerial attempts. A staff member expressed his concern about the teachers, who claimed to do PBL but doing something else,

> "I am not afraid of those staff who say they don't like PBL and keep away, I am afraid of those who say 'they are in', but in reality they are not."

Since there were so many different interpretations of PBL at a university, it was quite challenging for the managers to coordinate the staff members to work together. As a staff member commented, "*we require the students to work together, but we cannot work as a whole*."

Is the diversity of PBL interpretation avoidable?

The *normative-re-educative strategy* (Chin & Benne, 1985) was widely used to facilitate the staff's conceptual change. During the PBL implementation process, the university organized a lot of staff development programs to assist the staff members to recognize the value of PBL, to know what PBL was, and to know how to design a PBL curriculum and facilitate students' group work. However, there were a great many staff members who either doubted the value of PBL or had their own PBL conceptions, which were not consistent with the official attempts.

The organizational members' interpretations of a particular phenomenon are significantly conditioned by their "*fore-structure*" (Gallagher, 1992; Gadamer, 1995), which largely relies upon the tradition and the personal experience instead of the technical means. As this research shows, the diversity of PBL interpretations can be partially accounted by the difference of the organizational members' working and educational experience. The staff's interpretation of PBL as synonymous to problem solving can be linked to the staff member's working experience, as what we noted before. Further, as a senior manager commented,

> "This institution was a teaching institute, so there was very little research yet, it was just teaching in pretty much the traditional way of teaching. So the staffs in our faculty are here from that type of background, they are not researchers. If you are a researcher, if you got experience in research…you are not frightened of leading a project where you have to answer all sorts of crazy questions…because you are not showing them what the answer is and teaching it point by point… (old staff) don't have wide experience in research….feel a little insecure because they are afraid of students, be frightened of discover because they might be not able to answer the question."

Since most staff members at the university had little experience of researching, they were more likely to see teaching as a process of delivering the prescribed body of knowledge content, rather than a process of encouraging students to explore the unknown. This tradition may somehow explain that some staff members tended to interpret PBL in a traditional way. Since no staff member can escape from his or her own tradition, when a staff interprets PBL, he or she will bring his own tradition to the present, and thus creates his or her own understanding of PBL. Therefore, the diversity of PBL interpretation cannot be completely avoided.

Can a diversity of PBL interpretation be constructive?

When a university is implementing PBL, in general, the manager tends to use a normative approach to guarantee that the managerial intention can be realized. In this sense, the diversity of PBL interpretations at a university seems to be frustrating, since it sometimes leads up to huge tensions at the university, as we noted previously. However, the existence of the diversity of PBL interpretations, which were not quite consistent with the official attempts, should not be simply seen as a destructive force for PBL implementation at the university. Rather, they disclosed the problems and values of the staff members at the university because the interpretations of PBL were largely influenced by the tradition of the university, the disciplinary traits, as well we the staff members' personal working and learning experience. Further, it may also assist the managers and the staff members to constantly clarify their thoughts and make reflections on what they have done. As one staff member commented from a constructive perspective, "(*the pedagogical debates) actually lead us to having more understanding of PBL, and the staff who were not in agreement, and also where to change.*" The understanding behavior, whether what it is, is always productive because it constantly enables one to make relevance to one's current situation, and eventually renew him or herself, and the tradition in which he or she resides (Gallagher, 1992).

CONCLUSION

Interpretations of PBL in practice, especially the individual interpretations of PBL, are crucial for PBL implementation at a university, since it is the individual staff member who define

how PBL actually performs in reality. The implementation of PBL is much more important than the design process.

We should admit the diversity of PBL interpretations at a university. It is quite difficult to have a unified and coherent PBL interpretation among all staff members at a university. Rather, since staff members have their own *fore-structures* for understanding, their interpretations of PBL become quite diversified, and some of them are inconsistent with, or even contradictory to each other.

The diversity of PBL interpretations should not be simply viewed as a destructive force for PBL implementation; rather, it could be viewed from both destructive and constructive manners. On one side, the existence of different PBL interpretations would produce large tensions between different groups of people if a normative approach is adopted by a university to implement PBL. On the other side, it will help the staff members make reflections on their own thoughts and practices and thus bring new possibilities to a university.

Therefore, the management level should address the different interpretations of PBL when the managers want to implement PBL at the university. It is quite obvious that the managers should convince the staff members why PBL is more advantageously than traditional educational approach. More importantly, since there are various interpretations of PBL, they also need to convince the staff members why the university is going to use a particular type of PBL approach and why a particular PBL interpretation is more advantageous or appropriate than other PBL interpretations.

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Identifying needs to develop a PBL staff development program

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ABSTRACT

Staff development is a crucial element for educational intervention. Recognizing the importance of staff development, this study aims to pin-point suitable methodologies in developing a Problem-Based Learning (PBL) academic staff development program for a higher education institute where PBL has become an intervention alternative. The study aims to answer the following research questions 1) how can university academic staff be assisted to acquire pedagogical competences for an initiative of the implementation of PBL curriculum? 2) What kinds of support do university academic staff need in order to maintain PBL implementation? Through a combination of a literature review, interviews with 6 PBL experts which emphasize the importance of PBL facilitators, and document analysis of reflection notes from 18 trainees of a PBL workshop, this study will produce a guideline in developing a PBL Academic Staff Development Program for an institute wishes to implement and retain PBL as the education strategy.

Keywords: educational intervention, problem-based learning (PBL), PBL staff development, framework of PBL staff development program.

INTRODUCTION

This paper is the consequence of the preparation phase of design based research which is a part of my PhD research project. The overall PhD research project aims to design, implement, and evaluate a new model of Problem-Based Learning (PBL) curriculum for English interdisciplinary studies which are designed for a traditional learning environment in Thailand. Implementing PBL with the traditional education environment is considered a big

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change on many levels. Changing to PBL will involve changing or reshaping the mindset and practice of teachers toward educational pedagogy, the education system, and educational paradigm. Savin-Baden and Murray (2000) point out that when changing to PBL one of the important key elements which contribute to a successful implementation of PBL in any context is staff development. PBL staff development or training is very important because it provides individual teachers with opportunities and supports to improve their academic practice and consequently will enhance student learning. Therefore, academic staff is considered the very first component that needs to be developed if a university decides to implement PBL.

This paper aims to explore the existing theories and practices of PBL staff development program from the literature, to reflect on perspectives of PBL experts on the importance of PBL staff training, and to reflect the voices of PBL trainees from a Thai University. Based on data from various sources of the study, the paper continues to discuss and outline a guideline for developing a suitable PBL Academic Staff Development Program for a higher education institute. The qualitative empirical data is collected through document analysis from literatures and reflection notes of PBL trainees and from interviews with six PBL experts. Two research questions are formed in order to accomplish the objectives of the study.

1. How can university academic staffs be assisted to acquire pedagogical competences for an initiative of the implementation of PBL curriculum?
2. What kinds of support do university academic staffs need in order to maintain PBL implementation in their context?

METHODOLOGY

Overview

The study comprises reviewing and analyzing PBL staff development from the literatures along with empirical studies. Through the empirical studies, qualitative data was collected from two sources:1) semi-structured interview and 2) reflection notes of PBL workshop trainees. The interviews with six PBL experts at Aalborg University and Coventry University were in the form of a semi-structured interview where each expert was interviewed face to face separately, using the same interview guide. During the process the interviews were recorded. Another set of qualitative data was from refection notes of eighteen PBL workshop trainees who participated in a one-day PBL workshop conducted at Mae Fah Luang University in Thailand. The analysis of data from three different sources is in a form of content analysis.

Definitions

PBL experts in the context of this study refer to PBL academicians divided into two categories 1) practitioners who have been involved in supervising learners for over 2 years 2)

researchers and trainers who have been involved in researching and training newcomers of PBL practitioners. For this study, the interviews were conducted with 6 PBL experts.

Competences in this study refer to pedagogical competences which involve knowledge, skills, awareness, engagement, and personal commitment.

Setting and participants

Data collection was done in two stages. The first set of the empirical data was from semi-structured interviews which conducted individually with five PBL experts from Aalborg University and one PBL expert from Coventry University in the UK. These participants are experienced professors and researchers in the field of PBL. The second set of data was from reflection notes collected from eighteen PBL workshop trainees at Mae Fah Luang University in Thailand. The Participants of the second group are lecturers of Mea Fah Luang University from different disciplines.

RESULT OF LITERATURE REVIEW

Literature review is a part of the methodology of this study. This review aimed to provide an overview and analysis of the existing literature on PBL staff development. The review focused on two aspects: 1) The importance of PBL staff development when introducing PBL as an education strategy or intervention; 2) a summary of forms and contents of PBL staff development from different contexts. This review of literature consisted of two steps. First, searching and screening the relevant literatures by using the following key words: PBL staff development, PBL staff training, PBL faculty development, PBL tutor training. In addition, chapter 10 of the book 'Foundation of Problem-Based Learning' authored by Savin-Baden and Major (2004) was also use as the basis of the review and as a guideline in searching relevant literatures. Second step involved analysis and synthesis the selected papers. The framework used in analyzing and synthesizing the relevant literatures inspired by the work of Webster and Watson (2002) called 'concept matrix'.

The importance of PBL staff development

Implementing PBL at any level requires changes in learning and teaching methods. Dalrymple et al., 2006 advocated that when major pedagogical or curricular change takes place, there is really a need for an institution to embark on faculty development for better understanding of teaching and learning associated with the change. They described that when the University of Southern California School of Dentistry (USCSD) went through two major curricular reforms in initiating PBL with dental curriculum (D.D.S) in 1995 as a small pilot program and in 2001 as a large scale of entire school wide, both times required the initiation of faculty development programs. Especially in 2001 curricular change, PBL faculty development program "was identified as a component in the school's Strategic Plan for education and Learning" (p. 949). In order to maintain the implementation of PBL school wide, USCSD emphasized the importance of PBL faculty development by establishing a

subcommittee on Faculty Development, Mentoring, and Evaluation (FDME). Members of FDME were responsible for developing a program based on educational theories to accomplish the faculty development necessary for the implementation of PBL school wide.

Aldred (2003) addressed needs and challenges associated with PBL implementation and staff development at Central Queensland University (CQU). He took part of being CQU's Problem-Based Learning coordinator who was responsible for formulating a coordinated plan for PBL staff development. As CQU recognized that changing to PBL affected changing the learning paradigm, changing the design of courses and curricula, and changing learning and teaching methods; therefore, the CQU's PBL team spent over one year (2001-2002) in preparing staff and materials for the PBL implementation. The CQU-PBL Unit is working to support the further development of academic staff by ensuring that they have concrete and secure models and guiding their staff to implement PBL in their context whether with new or modifying existing courses or programs. To enhance advancement and quality of staff development, CQU incorporates the usage of technology, web-based activities for PBL staff development, as an alternative.

Bouhuijs (2011) points out that faculty development is an important tool to the success of PBL implementation. He further states that PBL cannot be viewed as only a simple application of a teaching method which can be transferred directly to any context without making changes. Changing to PBL cannot be done overnight; it can be a long process which requires a thorough preparation of change agents and faculty development is the tool for that. Teacher or staff is one of the major change agents who play a significant role in making the implementation of PBL successful. Implementing PBL at any level requires teachers to acquire educational skills which are different from traditional teaching skills. When introducing a change to PBL, it is necessary to have teachers on board with the idea because it is necessary to have their collaboration in the change process. Consequently, teachers themselves first need to be well equipped with current knowledge and skills in order to prepare and involve students in a PBL environment. For this reason, staff development has become an important means to prepare lecturers for the initiative of the implementation of PBL. Bouhuijs also states in his article that PBL staff development has been mandatory at the medical school in Maastricht since 1982. This can be concluded that the medical school in Maastricht has given tremendous importance to PBL faculty development as a key factor in implementing PBL successfully. Moreover, Bouhuijs also further states that besides an initial training for several days, a continuation of monitoring and support for teachers are parcel of the success of the PBL implementation.

Zaidi et al. (2010) describe the importance of initiating PBL faculty development, in a form of two-day training workshop in their case study, when the Foundation University Medical College (FUMC) introduced PBL into the medical curriculum in 2008. Even though the experience of PBL faculty training in Pakistan is limited, the FUMC managed to offer PBL

training workshops at a minimal cost to its faculty members in order to facilitate the PBL implementation in the medical school .The evaluation of PBL training workshops in the FUMC context advocates that the PBL training workshops result a positive influence on the faculty members' attitude towards PBL in terms of understanding and appreciation of PBL. Zaidi et al. further emphasize that the PBL training workshop is essential prior to the introduction of PBL in the curriculum because it helps the faculty members understand PBL, it also allow them an opportunity to practice their PBL facilitation skills.

Forms and contents of academic staff development in PBL

Savin-Baden and Murray (2000) state that in the field of PBL, staff development is perceived as the key to success to the PBL implementation. Furthermore, Kolmos et al. (2008) also pointed out that PBL staff development can be done in various forms, such as in a form of workshops, short courses, seminars, and long term pedagogical training programs; they however all have shared the same goal that is to assist individual lecturers acquires complex teaching competences which involve knowledge, skills, engagement and personal commitment.

At Mc Master University, facilitators' role is viewed as highly important for PBL development and self-directed learning. Therefore, facilitators' needs are identified in order to give ongoing support and training. Saarinen-Rahiika and Binkley (1997) describe PBL staff development program for Physical Therapist faculty that it involves workshops, independent reading, and faculty discussion. In addition, Saarinen-Rahiika and Binkley further explain that pairing inexperienced and experienced tutors for training, meeting with unit chair regularly to discuss unit objectives and receiving evaluation by students are important sources for tutoring skills development. Furthermore, Jung et al. (2005) state that there is a comprehensive training system which serves staff's needs in the PBL facilitation process at Mc Master. The training system comprises an orientation meeting, small-group tutorial observation, workshops, weekly tutorial meeting, monitoring unit, and yearly update workshops.

In the Medical School at Maastricht University, PBL staff training has been compulsory since 1982. The training program is in a form of mixture between pre-service and in-service activities in order to prepare and equip teachers for PBL environment. Workshops and seminars are provided as a platform to shape new learning and teaching behavior. During the work shop sessions, new faculty members confront different scenarios of expectations about teaching and learning, so in coping with the scenarios they experience PBL in action as learners and facilitators at the same time (Bouhuijs, 2011).

At Aalborg University, in order to assist new assistant professors to become more competent in their roles as PBL supervisors, the university provides a program called 'University Pedagogy for assistant Professors' as a part of professional development program. Krogh

(2010) explains that the teacher training course for assistant professors aims to ensure that assistant professors obtain knowledge of basic university pedagogy and education theory. This program consists of 3 modules which comprise series of workshops to help sharpen their teaching skills and competences. Within these three modules which last 15 months, there are PBL workshops which train faculty members to be adequately prepared to supervise students in the PBL environment. The course is mandatory in order to obtain a position as associate professor. The course is estimated at workloads of approximately 175 working hours within 15 months or 3 semesters.

PBL faculty development in the context of Australia has been documented as follows: Brodie and Jolly (2010) also report that PBL staff training program at the University of Southern Queensland is offered through a one day workshop and online up-to-date library of reference works. Similarly, Aldred (2003) describes the PBL faculty development program at Central Queensland University (CQU) comprises faculty-based seminars and workshops and web-based or online courses for academic staff.

At the University of Southern California School of Dentistry (USCSD), PBL faculty development program is running under the subcommittee on Faculty Development, Mentoring, and Evaluation (FDME). The program also comprises a series of sequential workshops called the PBL core skills workshops. The chronicle of running the workshops is as follows: first beginning with 1) the PBL process workshop; 2) the facilitation of learning workshop; 3) the assessment and feedback workshop; and 4) the PBL in the clinical environment workshop. Participants of the workshops have an opportunity to do role-playing with subsequent criteria-based feedback from the entire workshop group. In addition to the workshops, short introductory seminars and scenario-based discussions are used as the follow-up activities (Dalrymple et al., 2006)

RESULT OF THE INTERVIEWS

Six PBL experts were interviewed on topics related to the application of PBL, skills and competences of PBL facilitators, and the importance of PBL staff training. Three PBL experts are categorized as PBL practitioners (Pp) who have been teaching and supervising at Aalborg for 2 years plus. The other three PBL experts are categorized as PBL trainers (Pt) who have been teaching, supervising, researching and training other for five years plus. Data from the interviews presented in two formats. First answer category is the exact quotations from the interviewees. Second answer category is paraphrasing the interviewees' statements. Paraphrasing is used in the case when the answers were too long and some statements may not exactly answer the questions. The interviewer therefore asked the questions again and may add additional context to clarify the meaning of the questions. However, in paraphrasing the interviewees' statements, the main ideas are assured to remain the same and wording used

in paraphrasing were from the interviewees themselves. The following table contains the results from the interviews.

Table1: Answers from PBL experts associated with PBL facilitators and PBL staff training necessity

Interviewed Questions	**PBL practitioners (Pp)**	**PBL trainers or researchers (Pt)**
1) Do you think PBL can be implemented in any field?	Pp1: "Yes, it can be implemented successfully in any field, but need to bend depending on what level of education." Pp2: "Yes, but may depend on the contexts. However, it can be difficult for some fields that require a lot of literature through lecturing." Pp3: "It can be applied with none science fields. I don't see myself in a technical field. We are based on Humanities; for instance, we study problem solving in human development through IT."	Pt1: I rather use the term PBL inspired innovative pedagogy. Contextualization of student learning should be focused in order to make change or to make learning and teaching better. In some cases we should not label the practice or the philosophy of learning and teaching.(paraphrase) Pt2: "Yes and no, one form of PBL cannot apply to all. Each context, each discipline needs different kind of PBL." Pt3: "Yes, it can expand in most fields, but may difficult in pure Math. Implementation is about mind set of staff. They have to be creative to use PBL with different areas"
2) What types of skills and competences are necessary for PBL facilitators to acquire in order to make their supervision successful?	Pp1: They need to have an awareness of their communication skills, social or emotional intelligence in a relation to problem posing. They should be able to share atmosphere of research with students and help them gain competences to deal with the research process. (paraphrase) Pp2: "Having listening skills, trying to understand students rather have students understand you. Having an interest in students and their works. And also having experience and knowledge of literature in the field is also important."	Pt1: Depending on contexts—who are the students and who are the teachers? It also depends on how they (teachers) care about student learning, and then they will develop ways to teach better. (paraphrase) Pt2: "Having abilities to see and decode students. Having an interest in students' needs." Pt3: "Roles of facilitators change, depending on stages of where students are in the curriculum. At the beginning stage, facilitators need to be supportive and a bit more

	Pp3: "Being enthusiastic and inspiring. Also, being communicative—having dialogue with students."	directive. As students make progress, they need to step back and trust their students to take risks."
3) Will it be more beneficial to students if the PBL facilitators have background knowledge in the field they supervise?	Pp1: "At the beginning the facilitators should be more skillful in facilitation process which focuses on process and methods of the research. As the project evolves, the facilitators need to be more knowledgeable in the field. Or at least students should have an access to a person who can give advice on content as well" Pp2: "Yes and no, the negative of the facilitators have background knowledge in the field is that they can be too directive. And if they don't have background knowledge in the field, if can be difficult for them to challenge students. However, being too directive can be changed or modified through the reflection process." Pp3: "Not necessary. Because PBL is interdisciplinary, so ideally the facilitators need to be knowledgeable in more than one field. It also important that the supervisors dare to refuse to supervise the project that they don't feel they can supervise effectively"	Pt1: " It can be important in some cases" Pt2: "Should have both types. Some issues can be better seen by the ones who are in the field. For myself, I will be reluctant to supervise students from other fields." Pt3: "From research, there is no conclusive result. But it also depends on disciplines. To me, it isn't about the subject experts, but it is more about being a good facilitator, is the issue" A good facilitator must be able to ask questions to guide students to solve problems. (paraphrase)
4) To what extent is staff training necessary for the PBL classrooms or institutes?	Pp1: "Staff needs to have training of some kind and they also need to have supports all the way through from the faculty or the university. It could take up to 5-10 years if consider institutional change. Institutions need to be tolerant with uncertainty with the learning process and the outcomes of change"	Pt1: "Training is important for new teaching staff. It is a systematic way to institutionalize the teaching method. Institutions have to support to make the change in teaching and learning method happen" Pt2: "It is very necessary, even for someone who has been in the system before. Because

	Pp2: "Yes, new staff will need some training." Training can help raise an awareness of facilitators to help students build a strong argument of what they are doing and why they are doing that. And aware that they should not direct students too much. Otherwise, there is a risk that students will end up doing assignments rather doing problem-based project.(paraphrase) Pp3: "Yes, it is important, especially if you want to transform from a non- PBL university to a PBL university."	when they become facilitators, the contexts then change. So, they need training to help them see things in different perspectives." Pt3: "You need at least a year of preparation before implement PBL curriculum if you want staff on board properly."
5) What can be difficulties or challenges for PBL facilitators?	Pp1: "Teachers may have a hard time to realize that teaching is not equal to learning. They also may have a hard to admit that they don't know and have a hard time to get students involve in the learning process. And sometimes they don't see that both teachers and students must share responsibility in learning." Pp2: "Teacher may have difficulties to understand your roles in practice as PBL facilitators. The role of to help students learn by focusing on how to help students work rather than focusing on the result of a good project. Pp3: "It is hard to write good problems and it is hard to know all the approaches to cope with the projects." However, this type of difficulty can put supervisors to be on an ongoing learning mode with students, and consequently, supervisors will have to work	Pt1: "For me, the difficulty I have faced as a supervisor is to get Danish students to work with international students to develop intercultural competences." As for the difficulty I have faced as a trainer to university staff is to get them actually change in their perception and practice toward learning and teaching. (paraphrase) Pt2: "Difficulty in facilitating students is that it is hard to make them feel secure enough to be independent in decision making because they tend to work on you to get a recipe. And it is hard to know when to step in when they can't make progress and just continue to be frustrated. As a trainer, the difficulties are: 1) It is hard to make them reflect by combine theory and practice. 2) It is hard for new staff to believe that students can take responsibility of their learning." Furthermore, supervisors should not just give

	hard to catch up with new knowledge all the time. (paraphrase)	answers or knowledge to students because what seems to be good for students at the beginning will not be good for them in the long run. (paraphrase) Pt3: For new teachers who begin to implement PBL, their challenges can be how they see themselves as the teachers. It is very much about who you are as the teacher? And how you see knowledge (paraphrase)
6) How can university lecturers be assisted to acquire pedagogical competences for effective implementation of PBL curriculum?	Pp1: "Try out for themselves and also have training of some kind. Having a team of the teachers who share ideas and mission to support one another. These teachers should get support all the way through from the university or the faculty." Pp2: "Besides having supports from the system, teachers who have the same interest can also form a group of their own to exchange ideas and experience. Pp3: Having supports from top managers for the ongoing process of practice is a key factor of the success. (paraphrase)	Pt1: Training is important to new teaching staff. Institutions have to support in order to make the change happen. Training can be done in many different ways, for instance, inviting external experts to give workshops or sending staff to learn about new system. Financial support is an important issue. (paraphrase) Pt2: "Starting with actual practice along with training. During the process, it is important to be reflective facilitator, so having a team of teachers work together to discuss pedagogical issues is also necessary. Moreover, training program should be mandatory; the manager level needs to send a signal that they take this seriously". Pt3: The implementation of PBL very much depends on mind-set of staff. Before the actual implementation, they need to be trained in order to be on board properly. It will need at least a year for the preparation phase before the actual implementation takes place. (paraphrase)

Content of the answers from six participants can be analyzed as follows:

1) The PBL experts explicitly stated that PBL can be implemented with nearly every discipline, but adjustment or modification is required depending on each context.
2) The PBL experts all agreed that PBL facilitators must possess communication and social skills, and genuine interest in students' learning.
3) The PBL experts all agreed that during the PBL process students must have an access to a supervisor who can give advice on content but more importantly PBL supervisors must possess questioning skill which can guide students to solve problems.
4) All six PBL experts agreed that PBL staff training is very necessary for the initiation of PBL implementation. Moreover, the training should be viewed as an on-going developmental process of staff which requires a throughout support in various aspects from the university.
5) The PBL experts pointed out, from their experience, that the most challenge and difficult of becoming a PBL facilitator is that how teachers truly understand and practice their roles and functions appropriately in accordance with students' learning.
6) Staff is one of the major factors contribute to the effective initiation and maintaining PBL practice. Consequently, the support they need can be put into three elements. First they need a community of practice which comprises their peers who have the similar mind-set and interest associated with learning and knowledge. Second, they need a systematic training which fosters the advancement of their practice. And third, they need a long term and systematic support from the top managers of the university.

RESULTS FROM PBL WORKSHOP TRAINEES' REFLECTION NOTES

After attending the general PBL workshop conducted for faculty members of Mae Fah Luang University from various disciplines, participants were asked to reflect what they have learned after attending the workshop and what they need in assisting the PBL implementation in their context by completing the post reflection notes. The reflections from participants can be an indicator of how useful this type of workshop is to the PBL implementation initiative and what else they need in order to initiate and retain the PBL implementation. The results are presented using concept matrix to categorize the reflection notes and the results are as follows.

Item 1, the participant were asked to identify whether or not their concept about learning and teaching has changed after attending the PBL workshop hosted by the PBL expert.
The answers can be grouped into three categories:

Category 1, the answer was yes; their concept of learning and teaching had changed. Three teachers expressed that their concept of learning and teaching had changed completely form teacher controlled everything to allowing students' participation, as they just realized that " teaching and learning need teachers to step back and allow open floor for students".

Category 2, the answer was no, their concept of learning and teaching had not changed. Five teachers reported that their concept had not changed.

Category 3, no answer for this question by two teachers and one teacher said "not sure".

Item 2, the participants were asked to identify the concept of PBL and stated the differences (if any) of their concept of PBL before and after attending the workshop.
The answers can be grouped into three categories:

Category 1, their concept of PBL had changed after attending the workshop. Three teachers stated that now I just realized that "PBL is not project based"; "PBL emphasizes process, not just gives problem(s) to students"; and "PBL emphasizes an opened floor for students to learn by themselves".

Category 2, four teachers reported that their concept of PBL had not changed after attending the workshop, but they understood PBL principles and practices better than before attending the workshop.

Category 3, no answer; four teachers omitted this item.

Item 3, the participants were asked to explain the value of the workshop in their perspectives; what do you find most valuable about the workshop?
The answers are as follows:

"Knowing that PBL has different levels"; "PBL can be used as a motivation drive in learning";
"getting ideas and tips to put PBL into practice"; "sharing experience"; and "increase confidence to teachers in implementing PBL".

Item 4, the participants were asked to identify what they have learned from the workshop.
The answers are as follows:

Definition of 'problem' in PBL approach (2 teachers); team aspect is considered important element of PBL (1 teacher); How to apply the theory of PBL (4 teachers);

PBL has limitations in some subjects (2 teachers); roles of teachers and students in PBL environment (1 teacher); PBL will be effective if the facilitator understand the concept of PBL and has some expertise in taught subjects (1 teacher).

Item 5, the participants were asked to identify strengths of the workshop. The answers were as follows:

"The speaker is an expert in the field and has an open-mind";
"Learning strategy of the workshop allows participants comprehend PBL concepts by themselves";
"Group discussion allows participants to exchange teaching experience".

Item 6, the participants were asked to identify weaknesses of the workshop. The answers were as follows:

"Some content is too advance and complex";
"The workshop is too short, workshop is held during the holiday;
"There are many passive participants."

Item 7, the participants were asked to convey what they need in order to implement PBL in their context. The answers were as follows:

Seven teachers conveyed that they "need supports and collaboration from top managers, curriculum designers, and colleagues".

One teacher said that she "needed students to understand why teachers don't give as much lecture as before".

Two teachers expressed that they need "PBL template more training". One teacher did not respond on this item.

DISCUSSION

It is a huge challenge to transform a traditional teaching and learning environment into an innovative learner-centered environment, particularly what is called Problem-Based Learning system (PBL). There are so many factors that need to be taken into consideration in order to make the transformation effective. One of the key factors in transforming to PBL system is staff training or staff development. This study aims to design a framework of a new PBL staff training program for a higher education institution. Through the means of data collection by reviewing literature, interviewing PBL experts, and elicit opinions and insights from PBL workshop trainees indeed give a valuable insight for designing a framework of PBL staff

development program. Data from different sources all point out that in order to initiate an effective PBL implementation; at least a year of preparing academic staff is required. In preparing the academic staff, a PBL of community practice, a systematic training program, and a formal support from executive managers in terms of policy and financial issues are also required from the very beginning. An establishment of a systematic PBL training program and the community practice will be the platform for staff to gain in-depth understanding and competences in both theory and practice of PBL. The reflections from different studies from the literature, the PBL experts, and the PBL trainees, together inspire the proposed framework for a new systematic PBL staff development program for a higher education institution. The proposed program consists of two major elements: 1) a sequential staff training activities and 2) a PBL community practice. The figure below demonstrates parameters needed for a framework of PBL staff development program (initiative).

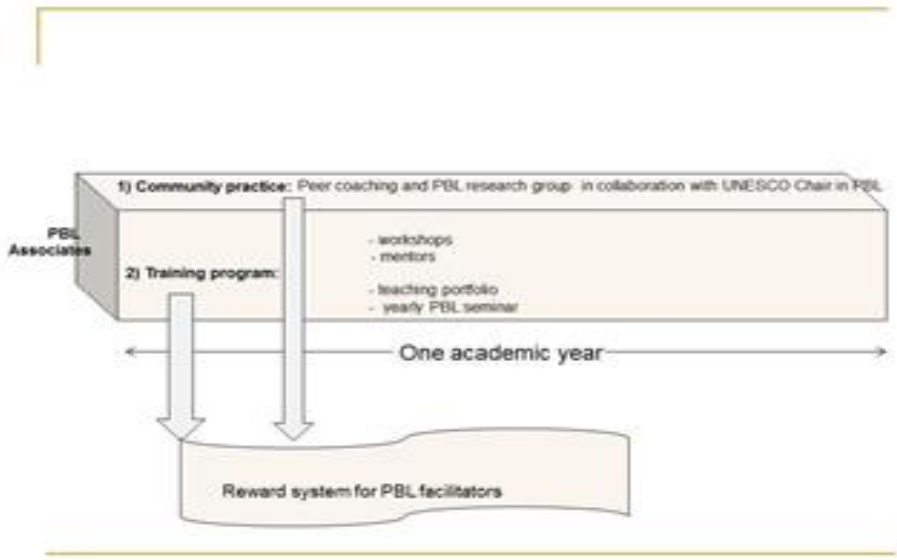

Figure 1: A Framework for a PBL Staff Development Program

As shown in figure 1, in order to implement PBL effectively, a unit of PBL associates should be established. Two major functions that PBL associates can provide are:

1. Provide a sequential training program for staff which consists of four elements (mandatory).
   1.1 A series of PBL hands-on workshops which will be offered throughout an academic year.
   1.2 PBL mentors who would help PBL practitioners reflect on both PBL theory and practice via meetings and portfolios. At the very beginning the mentors can be external and after a year of training the organization can slowly assemble its internal mentors.

1.3 Portfolio as a tool to reflect on the actual practice of each practitioner approved and assessed by mentors.

1.4 A yearly PBL seminar as a platform to present and share their experience.

2. Provide PBL community practice as a platform for staff to support one another informally (optional). PBL community practice consists of two elements.

2.1 Peer coaching which can be initiated and managed by the practitioners themselves.

2.2 PBL research groups which will be mentored by and collaborated with the PBL Network under the support from the UNESCO Chair in PBL. This PBL research group can be a platform to support PBL practitioners to build their research skills and connect with other PBL practitioner networks around the world.

One more important issue that needs to be included in this discussion is a reward system for PBL practitioners. Going through a change process without proper support can be very frustrating and easily result in failure. Especially considering that the change process of implementing PBL will require a long period to see significant results. This long process will require a vision in life- long learning, strong leadership and support, a commitment from both staff and executive managers, and a tolerance for the long term process. Particularly, teachers who participate in the change process will have to contribute time, energy, and intelligence throughout the process. They therefore also need concrete and structured support from the institution.

CONCLUSION

This paper supports that staff development is one of the central elements in implementing PBL initiative as well as maintaining the PBL implementation. PBL staff development needs to be put into an action plan from the very beginning when a higher education institution wants to implement PBL. Without a doubt, it will be hard work for all agents when it comes to a change of any kind. Therefore, having strong support from all levels in the organization is important and valuable. Making a change in an education system is a long process which requires support, commitment, creativity, and tolerance from all agents. As recommended by PBL experts, preparation of the staff alone can take at least a year before the actual implementation; therefore, having a well prepared staff to begin with is a good alternative. A well prepared staff can indeed come in the form of a PBL staff development program. In most case PBL staff training has been done mainly through a short workshop format; however, this study proposes that adding more a systematic long term training and support elements which will not only make a strong PBL implementation initiative, but will also maintain the PBL practice of the institution. As PBL should not be viewed as an add-on teaching approach; it should be embedded in the system. Therefore, the PBL staff development program should also be embedded in the staff evaluation system (reward system) as well. It is recommended that establishing a sequential PBL training program along with a PBL community practice can be a sustainable strategy for implementing and maintaining PBL practice because these two

units will be platforms for the PBL practitioners to share ideas and experiences, as well as support one another in their pedagogical stance.

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Dimensions of problem based learning – dialogue and online collaboration in projects

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ABSTRACT

The article contributes to the discussions on problem based learning and project work, building on and reflecting the experiences of the authors. Four perspectives are emphasized as central to a contemporary approach to problem- and project-based learning: the exploration of problems, projects as a method, online collaboration, and the dialogic aspect of students' project work. A specific focus is on how the problem- and project-based learning approach developed in Denmark historically and theoretically, and how it unfolds today discussed through a case of the Danish Master programme in ICT and Learning (MIL), focusing on changes in the roles of teachers as supervisors, and the involvement of students in course and project activities.

Keywords: Project work; Problem based learning; Dialogue; Online learning; Group collaboration; Teacher roles

INTRODUCTION - APPROACH TO PROBLEM BASED LEARNING

In this article our aim is to contribute to the approach of problem- and project-based learning in a present context and identify perspectives that are relevant to further development. As an alternative to more curriculum-oriented teaching approaches, problem- and project-based learning have developed over the last decades into an institutionalised approach (Barron et al., 1998; Kolmos et al., 2004; Olesen & Jensen, 1999). We will reflect on the history and theoretical roots of the problem- and project-based learning approach, particularly as it has developed at the Danish 'reform universities' of Roskilde and Aalborg, and we will point out

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four perspectives that seems central to the approach today. The first of these perspectives focuses on what is understood in the notion of *problem*, building on the tradition of 'problem based learning', PBL, and its development. The second perspective deals with the notion of *project* work and what constitutes the concept of 'project'; in this perspective we are building on insights from Kilpatrick, one of the first to reflect project work theoretically (Kilpatrick, 1918). The third perspective of our approach focus on collaborative *online* learning activities, as new technologies open up possibilities for student interaction across time and space; here we build on traditions of computer-supported collaborative learning, CSCL, and networked learning (Koschmann, 1996; Stahl et al., 2006). As the fourth perspective we emphasize a *dialogic* approach to communication and learning as central to working with problems and projects (Wegerif, 2013). The four perspectives outlined here does not necessarily constitute a fixed or final approach, but can be seen as our suggestion for current problem- and project-based learning in higher education. Hence, the combination of these crossing perspectives may develop, and new perspectives might be integrated over time.

THE FIRST PERSPECTIVE: EXPLORING PROBLEMS

The first perspective to emphasize as part of our approach deals with problems: exploring and working with problems as a didactic method. The tradition of problem based learning (PBL) dates back to the late 1960s and the beginning of the 1970s, where it developed especially at the universities of McMaster University, Canada; Maastricht and Twente, The Netherlands; Salford, UK; Tromsø, Norway; and Linköping, Sweden (de Graaff & Kolmos, 2003; Andreasen & Nielsen, 2013). At the time, PBL offered a new perspective to the existing teaching practice, a perspective where students gained their own experiences through working with practical cases, often based in real-life, instead of listening to teachers lecturing.

Barrett and Moore describes the PBL method by stating that "a key characteristic of PBL is that problems are presented to students at the start of the learning process rather than after a range of curriculum inputs. The PBL problem can be a scenario, a case, a challenge, a visual prompt, a dilemma, a design brief, a puzzling phenomenon or some other trigger to mobilise learning." (Barrett & Moore, 2011, p. 4). Still, in the original PBL tradition it is the responsibility of the teacher to present the problems to be dealt with and to demonstrate how students can relate curriculum and theories to praxis in a constructive way. Barrett and Moore thus explains: "It is important for us, as PBL practitioners, to continually find new ideas for selecting and designing relevant, motivating, challenging, interesting, multi-faceted and up-to-date problems for our students" (Barrett & Moore, 2011, p. 5).

Even though the teacher in this approach often selects a range of topics and problem areas that students may work with, it is also important for students to have wide opportunities to make critical choices and decisions. "The more decisions the students are able to make, the greater their motivation. Even though there are specific learning objectives, the students must have

enough freedom to get maximum enjoyment from the work. This is a very central didactic consideration“ (de Graaff & Kolmos, 2003, p. 660).

The relation between students' problem-based activity and their experiences from their working life - and generally from the world outside university - is valuable, not only for the students' motivation, but also for their development of relevant competences, as pointed out by Barrett and Moore: "Employers regularly highlight the importance of key skills, which include: communications, teamwork, information literacy, critical and creative thinking, and problem solving, together with self-awareness, self-assessment, ethical behaviour, reflection, and responsibility for continuous development." (Barrett & Moore, 2011, p. 7).

THE SECOND PERSPECTIVE: PROJECTS AS METHOD

Working with problems and working with projects often have many common traits. However, where a problem based approach will often have in focus working with practice-related cases, a project-based approach will often have in focus the students' own responsibility for developing and directing their work.

The idea of using project work as a method for teaching and learning is generally attributed to the American Professor of education William Kilpatrick (see eg. Postholm, 2003, p. 39; de Graaff & Kolmos, 2003, p. 659). Kilpatrick was originally a student of educational philosopher John Dewey. In an often-referred article (Kilpatrick, 1918), he discussed the new concept of working with 'projects', which was becoming more widely used in educational contexts. What did this concept offer to the understanding of education? According to Kilpatrick, a 'project' should be defined and understood as a "wholehearted purposeful activity proceeding in a social environment" (Kilpatrick, 1918, p. 320). From this definition we can identify four characteristics of projects: To Kilpatrick, a project entails a concrete *practice* ('activity') which has a *goal* (is 'purposeful') and in which participant(s) are engaged or feel *motivated* (are 'wholehearted'), and furthermore this practice takes place in a *context* or social setting ('social environment').

To Kilpatrick, the process of 'being engaged in purposeful acts' offered an alternative approach to the education of children. Kilpatrick was critical of the established instructional practice, which he described as often consisting of "an unending round of set tasks" (Kilpatrick, 1918, p. 328) of abstract nature with only little relevance for students´ life experiences. Instead of this practice, the students would by working with 'purposeful acts' be able to find relevant meaning and thus be motivated in their learning activities. Thus, Kilpatrick's purpose was through motivation to create ownership of the specific project and engage the student in taking responsibility for the learning process.

Projects are not to be seen as one unified thing, but may take on different forms. In order to be more precise in the vocabulary of working with projects, Kilpatrick classified different types of projects: Type 1: embodying an idea in external form (eg. building a boat, presenting a play); type 2: appreciating an aesthetic experience (eg. hearing a symphony, appreciate a painting); type 3: finding an answer to an intellectual difficulty, or solving a problem (eg. why did N.Y. become bigger than Philadelphia?); and type 4: acquiring a skill or a degree of knowledge (eg. learning irregular verbs in French) (Kilpatrick, 1918, p. 332-33). These four types of projects may to some extent overlap or partly depend on each other. Relevant to the discussion of problem- and project-based learning is especially type 1 with the aim of creating a kind of product, and type 3 on investigating and solving a research question. Kilpatrick notes himself that with his definition of project types, the problem method is included as one way of working with the project method.

Kilpatrick's position, emphasizing the child's development of motivation, was later reflected by his former teacher, John Dewey. Dewey advocated the same claim that pupils ought to work on topics they are interested in, and not be limited to topics imposed by the teachers, but he was critical of Kilpatrick for focusing too much on the child in itself and the individual development of motivation. According to Postholm, Dewey would rather see project work as a joint activity involving students as well as teachers, with an emphasis on the teacher's role as an advisor that guides or directs the pupils towards a goal (Postholm, 2003, p. 39).

THE THIRD PERSPECTIVE: ONLINE COLLABORATION

Since the 1990s, students' opportunities for integrating new technologies in their problem- and project based work have opened up, and collaboration through technology has come to play an important role in organising learning processes. More traditional distance learning where students individually were expected to give answers to posted materials such as questions, quizzes, and tasks posed by the teacher, have developed and paved way for models where students are encouraged to work together constructing their own knowledge through collaboration and with the support of computer technology (Koschmann, 1996; Stahl, Koschmann & Suthers, 2006). Dirckinck-Holmfeld views learning in this tradition as a "social construction and negotiation process mediated by artifacts between humans" (Dirckinck-Holmfeld, 2002, p. 32). According to Stahl and collaborators "the group itself has become the unit of analysis and the focus has shifted to more emergent, socially constructed, properties of the interactions" (Stahl, Koschmann & Suthers, 2006, p. 7), building on socially oriented theories of learning, social practice theory, and dialogical theories of learning. Computer and networked technologies provide environments that could enhance the practices of group meaning making. Koschmann presented a programmatic description of CSCL in his keynote at the CSCL conference 2002: "CSCL is a field of study centrally concerned with meaning and the practices of meaning-making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts." (Koschmann 2002, p. 18). The

title of this keynote is, interestingly compared to our discussion above of the roots of project-based learning: 'Dewey's contribution to the foundations of CSCL research'.

In problem- and project-based learning, activities often take place in networks, and the aspect of networks is in focus of the research tradition of networked learning. In our understanding the term 'networked' implies a double meaning; on the one hand the term 'networked' refers to being in a network collaborating with other people (fellow students, teachers, or others); and on the other hand 'networked' refers to being connected through electronic networks to the online facilities and possibilities available (eg. for sharing, studying, or communicating). Banks et al. define 'networked learning' as "learning in which information and communications technology is used to promote connections: between one learner and other learners; between learners and tutors; between a learning community and its learning resources." (Banks, Goodyear, Hodgson & McConnell, 2003, p. 1).

Dialogue has always been of importance when people are working together, sharing ideas, constructing knowledge, but the networked technology makes this dimension more explicit. Wegerif and de Laat points to how technology can be seen as a "facilitator opening and shaping dialogic spaces that would not otherwise be there." (Wegerif & de Laat, 2011, p. 317).

THE FOURTH PERSPECTIVE: A DIALOGIC APPROACH

The fact that collaboration is difficult is what also makes it a possibility for learning. The Norwegian psychologist Rommetveit emphasized, from a dialogic perspective on education inspired by Bakhtin (Bakhtin, 1986), that asymmetry between participants in a dialogue can be supportive of discovering new perspectives (Rommetveit, 1996, p. 95). Entering into dialogue is an exchange with other perspectives. Thus, a creative learning environment is not necessarily established only through harmony and consensus, but may rather be developed by allowing for asymmetry and difference. With differences, more voices may come into play and interact, and by relating to different voices offering different perspectives, chances are to learn and develop.

According to Bakhtin, we develop or "author" our identity by positioning our voice in relationship to the voices of others - voices that may be present voices, past voices, or anticipated future voices. In a study of student teachers in their pre-service training, who collaborated through web-based blog- and wiki-communication, Burwell writes that: "Through the process of negotiating between and among voices in dialogue and then articulating new understandings either verbally or in writing, a teaching identity emerges." He here points out that the student teachers used their authoring of utterances and their interaction with each other to develop their identities as teachers (Burwell, 2010, p. 5092).

In another study of a course helping new teachers taking advantage of technological resources for teaching and learning, Mahiri reflects that the new teachers were helped in changing their perceptions through the dialogic relationships in the class and their collaborative writing of texts (Mahiri, 2004, p. 230).

Wegerif and de Laat reflect on the challenge for education today of developing higher order thinking. One of the tendencies in the knowledge-based information society of today is the general decrease of low-skilled and semi-skilled jobs and the growing importance of such skills as critical thinking, making reasoned decisions between alternatives, or innovating new approaches, what is often termed higher order thinking skills (Wegerif & de Laat, 2011, p. 313). The concept of higher order thinking is often attributed to Bloom in his development of a taxonomy of learning categories. Here higher order thinking is located in a hierarchy from 'lower levels' like remembering and understanding to 'higher levels' like analysing and evaluating. This taxonomy can be criticized for its linear understanding of learning as developing through these levels, and for its foundation in an individualised, cognitive psychology. However, the term 'higher order thinking' still points at relevant competences needed today as being reflective, innovative etc. This also applies in the context of problem-oriented project work, where the development of analytic skills and processes of meta-cognition, continuing self-evaluation and reflection are central.

Therefore, instead of dismissing the concept of 'higher order thinking' for its understanding of thinking and learning as predominantly individual and cognitive processes, Wegerif and de Laat argue for a reconceptualisation of 'higher order thinking and learning skills' as socially situated practices, and as a property of dialogues. Wegerif and de Laat therefore elaborate on the importance of 'dialogic reflection' as the primary higher order thinking skill (Wegerif & de Laat, 2011, p. 314).

Within the dialogic and social constructivist tradition meanings can never be final and fixed once-and-for-all, but are open to re-interpretation. Meaning and knowledge are established through dialogues, which may take place internally as well as externally. Wegerif argue that a dialogic approach should not solely be considered a *means* for participating individuals to reach a negotiated goal, but should rather be considered an *end* in itself, since people through engaging in dialogic processes will be able to construct knowledge and develop reflective thinking (Wegerif, 2013). Wegerif and de Laat states that "Thinking always occurs within dialogues (both internal and external to individual minds)" (Wegerif & de Laat, 2011, p. 316).

LEARNING THROUGH PROBLEM- AND PROJECT-BASED WORK

The four perspectives discussed above are to us elements of a contemporary problem- and project-based learning approach. We will in the following point out some main characteristics of learning through problem- and project-based work.

Problem-oriented project work is an active and participant-directed kind of learning (Illeris, 1999). Central to the process is the students' own formulation of a research question, which they then investigate during their project work. In this process the students negotiate what problems to deal with, enter in continuing dialogues and investigations with each other, and together develop a product, eg. a written project report (Mallow, 2001, p. 107). The project-organised learning approach is characterized by problem-orientation, interdisciplinarity, experiential learning, principle of exemplarity, and participant-directedness (Nielsen & Webb, 1999). Through this approach students relate their new insights to their previous experiences and hence through their study process construct new valuable skills and experiences, expanding beyond the specific frame of the project. The process is interdisciplinary in that the research question will often require combining knowledge and ideas from different kinds of academic fields (Olsen & Pedersen, 2005).

The process is often characterized by collaborative project work in groups. When students work as members of a group, their learning involves both individual and co-operative activities. The students need to act as well *independently* - at an individual level to take initiatives, propose solutions and choose between possibilities - as *interdependent* - at a group level to develop methods of working together, communicating clearly, agree on decisions, and benefit from the shared effort. The aim is to develop a productive interaction through discussions and collaborative writing processes, leading to a final project report.

Processes of learning are often associated with difficulties and laborious work, as elaborated by the Danish learning theorist Knud Illeris: "The learning process may take the form of coming through a crisis, in which the learner struggles for a certain length of time with a problem which is of urgent subjective importance" (Illeris, 2004, p. 58). Frustrations for students working in groups may in periods reach a high level, and tensions, misunderstandings and conflicts among the participating students can occur. De Graaff and Kolmos refer to empirical findings from students' group work, that co-operation among group members can be difficult (de Graaff & Kolmos, 2003, p. 659). As pointed out students often invest much time and energy in project work, and their feeling of ownership is crucial in order to engage in the extraordinary work that often lies within the carrying out of a project.

The pedagogical approach of project-organised learning can be said to reflect the new needs for qualifications that occur in the transition from an industrial society to a knowledge-based information society (Dirckinck-Holmfeld, 1996; Wegerif & Mansour, 2010). Skills like the ability to communicate, engage in teamwork, be innovative, dynamic and flexible, and carry out problem solving relate to these societal changes (Krogh & Rasmussen, 2004, pp. 40ff). Through students' project work such skills are developed: communicative and listening skills, ability to show respect and understanding for one another, and to reflect on their personal development (de Graaff & Kolmos, 2003). They also develop skills in co-operation and

project management through learning how to plan, manage, and evaluate projects. This is a long-term process for the students, that will be gradually developed through participating in a number of project work cycles.

HISTORICAL DEVELOPMENT AND THEORETICAL ROOTS

In the light of this discussion of problem- and project-based learning, we will draw out some characteristics of how the approach has developed historically and theoretically in Denmark.

In Denmark PBL took its form as problem- and project-based learning especially at the 'reform universities' in Roskilde and Aalborg, which were founded in 1972 and 1974. The pedagogical innovations that lay behind this development came through contacts among educational researchers and practitioners representing alternative, critical pedagogical approaches (Nielsen, 2002, p. 56). Various sources of inspiration were combined from among others Dewey, Piaget, Negt, Lewin, and Freire, some of which will be discussed in the following.

Dewey was an inspiration through his description of the process of "experiencing". He pointed to the integrated dimensions of *continuity* and *interaction* as playing a central role when students learn through relating their new insights to their previous experiences: "The principle of continuity of experience means that every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after" (Dewey, 1963 [1938], p. 35). Students develop their experiencing through interactions, relations and dialogues among participants.

Negt was another inspiration, who reformulated Dewey's understanding of "experiencing" as an active, productive process in a societal context. Negt especially focused on developing workers' conditions and consciousness (Negt & Kluge, 1993 [1972]; Illeris, 2004, p. 150ff). Negt also emphasized the principle of exemplarity, which meant that the question in focus of a project can be seen as an example of something 'bigger'. Thus students working with a specific research question will not only be capable of understanding this in depth, but also of seeing it in a wider context and be able to 'transfer' their findings, their approach and their methods to other research areas (Negt, 1975 [1968]).

Lewin's notion of dynamics within groups, his understanding of experiential learning and his experiences within the field of action research was a third inspiration. Lewin underlined the importance of interdependence - as discussed above on the relation between independence and interdependence - among group members (Lewin, 1948). Lewin stated that a powerful dynamic can be created if a group's tasks are such that members of the group are dependent on each other for achievement.

Lewin's three stage change model developed within organizational research is another relevant notion in relation to students' collaborative project work (Lewin, 1951). The first stage of this model is *Unfreeze.* Group members should be aware of problems and tensions in the current stage of the functioning of the group. The more people recognize that a need for change exists, the more likely they are to "unfreeze" from their current mode of operation and become receptive of new ways to work. The second stage is *Change*. People who have been "unfrozen" are in a transition that can result in a change of behavior or procedure that can help them become more effective team members. The third stage is *Refreeze*, where new procedures, thought patterns, and behaviors are to be accepted and implemented in order to be part of the ongoing practice. Such processes of unfreeze, change and refreeze will continually take place.

At the Danish reform universities these inspirations were unfolded in practice in a way where the learning environment was structured in specific physical surroundings, 'houses'. In these houses a cohort of 65-100 students was located for joint studies during several semesters. Here students organised their project work, had courses and held seminars. Until the 1990s, during these project periods, the teachers had - and the study secretaries still have - their offices in these 'houses'. Thus a milieu characterized by participant-directedness emerged, where students and teachers together could build an inspirational learning environment and as a result a wide variety of competencies could be produced. Such environment paved way for the development of social competencies - e.g. democratic participation through the ongoing discussions and negotiations, not least in relation to contested issues in society in general.

From the beginning of the 1990s and onward, Lave and Wenger's terms of situated learning and communities of practice have been of inspiration, e.g. for the MIL programme, which is discussed below. The concepts of *joint enterprise* (negotiation of common goals, conducting joint project work), *mutual engagement* (mutual responsibility for the task and the activities undertaken, doing things together, group relationships, community maintenance), and *shared repertoire* (actions, artifacts, tools, work styles, learning styles, concepts, discourses) (Wenger, 1998, p. 73) have been relevant for project-organised learning, in relation to supporting learning processes in groups.

A final development in relation to project work is the way of assessment. De Graaf and Kolmos underline that assessment and exams should take place on a group basis if a project is made by a group (de Graaff & Kolmos, 2003, p. 659). This was actually the case in Denmark until 2006, that group projects could be evaluated through group exams. However, in 2006 the center-right government issued a law that even if a project work had been undertaken as group work, all examinations should take place individually. In 2012, the center-left government reversed this law, and it is now up to the educational institutions themselves to decide the kind of assessment form. Aalborg and Roskilde universities (including the MIL programme)

have accordingly decided that students' learning process involving group project work should be assessed through group examinations.

A project pedagogy process in MIL has a variety of different phases, ranging from face-to-face meetings between supervisor and student group to communication through digital media in virtual learning environments featuring written communication, audio and video. The roles of students and teachers change during a project working period, as discussed in the next section.

TEACHERS' ROLES AS SUPERVISORS

In the following, we will discuss some of the changes related to the roles of being a teacher and a supervisor in the context of project work and problem based learning. Usually when dealing with design for learning, the teacher or professional instructor is responsible for the planning and implementation of the teaching and learning process. Within project-organised learning it is however crucial that also students can act as co-designers of the learning environment.

Within the framework of project-organised learning, the teacher's main role is acting as a supervisor - not solely as a lecturer or instructor. When students are involved in participant-directed study processes, they are in contact with a teacher, who acts as a supervisor in relation to their project. As a supervisor the teacher may act as a coach, a mentor, a discussion partner; as one who supports as well as challenges the students in their project work. This is done by being initiating in relation to the students' projects and showing possible ways to go for the students, but at the same time without taking too much responsibility. The reciprocity in the teacher-learner relationship is of great importance.

The specific needs for supervision in relation to students' project work are studied by Dahl, who outlines an understanding of student-tailored supervision (Dahl, 2008). By 'student-tailored' he means that the supervision should be continuously adapted by the teacher to the needs of the students, in a way that matches different combinations of process-oriented and product-oriented guidance, of which Dahl terms the basic combinations 'consulting', 'discussing', 'training', and 'instructing' (Dahl, 2008, p. 93). A supervisor should not just give the students what they want, but should instead stimulate the students to transgress their familiar abilities and to enter new areas of activity. Following the terms of Vygotsky the supervisor should facilitate the students to enter their 'zone of proximal development'. Vygotsky defines this zone as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). The zone of proximal development is thus the area

between what a learner can do by him- or herself and what he or she can do with help from more knowledgeable persons or groups of people.

This concept of students' proximal development zone has contributed to a focus on relating the teaching effort towards the specific students and their actual experiences and possibilities. The use of the concept has however also been criticised, eg. by Illeris and Engeström (Illeris, 2004, p. 54) who asserts that the teaching-learning process implied in the concept of "proximal development" may take form of a teacher-controlled and somewhat authoritarian form of teaching, as the teacher is the one that knows best in which direction the student may develop. In their criticism they cite Griffin and Cole: "Adult wisdom does not provide teleology for child development. (...) A zone of proximal development is a dialogue between the child and his future; it is not a dialogue between the child and an adult's past" (Griffin & Cole, 1984, p. 62, here from Illeris, 2004, p. 55). This reformulation involves as Illeris remarks an understanding of the zone of proximal development as a space for creativity for the child, or in our case the student. As Engeström puts it: "We must stop talking about the acquisition of what has already been developed, and understand that what is important are creative processes" (Engeström, 1987, p. 169, here from Illeris, 2004, p. 55). Such understanding we see as essential for project-organised learning processes to build on the students' initiatives and new ideas.

When dealing with online learning activities, new roles and tasks for the teacher appear compared to the well-known practice of classroom teaching. In relation to higher education, Kahiigi et al. suggest that when teaching online "the teacher takes on a facilitator role while the students take ownership of their learning and personal development" (Kahiigi et al., 2008, p. 82). Based on our experiences from teaching at the MIL programme, we will point out that teaching online creates a need for technological as well as social awareness, where teachers should be visible and accessible through online discussion periods, in other words mobilize tele-presence. The challenge for the teacher is to allow adequate space for students to operate and navigate, but at the same time provide clear criteria and standards to make sure students understand the tasks and activities. Especially in online activities it is important to assist the students to stick to their work and hold on to their plans. An online supervisor must be capable of giving constructive feedback, either face-to-face or through various synchronous communication programs such as Skype, Adobe Connect, or Google Hangout. Sometimes it also demands being available at odd hours.

With the multi-faceted communication modes within reach today, we often find that a distinction can to a lesser degree be drawn between whether people are online or on-site, but may follow other lines, for instance whether one prefers communicating synchronously or asynchronously.

Thus, the role of the teacher is developing in current educational settings. In relation to project supervision, we may outline three general positions, which can be described as: the lecturer position; the facilitator position; and the mediator position. The first position, *the supervisor as a lecturer*, is an instructive teacher position, where the teacher is giving professional advice as an expert. The second position, *the supervisor as a facilitator*, is more related to methodological aspects, with an emphasis on qualifying the students' choices during the project work and supporting their ongoing reflection on their learning process. The third position, *the supervisor as a social mediator*, deals eg. with the difficulties that may occur when students are collaborating. In the mediating role, the supervisor will mainly be inquiring in order to facilitate student engagement in explorative dialogues (Nielsen & Danielsen, 2012, p. 263-265). In practice a teacher and supervisor should be able to take on all three kinds of positions depending on the phases of the project work and the situation of the students.

THE MASTER PROGRAMME IN ICT AND LEARNING (MIL)

In the following we will concretise the discussions on problem- and project-based learning through examples from the Danish postgraduate Master programme in ICT and Learning (MIL). MIL is a part-time programme, most of the students are employed full-time or part-time while studying, and the students come from all parts of the country. The MIL programme was established in 2000 as a continuation of a national research network, and is being offered as a joint programme between four Danish universities.

The programme builds on a networked learning structure and combines on-site seminars every second month with online periods of course activities and project work. The pedagogical model of the programme builds on didactical principles of student engagement in formulating research questions, enquiry of exemplary problems, and interdisciplinary approaches. In their projects, the students bring in research problems from their own work practice to study, while using theories, concepts and methods from the academic practice (Fibiger et al., 2004). Thus, the Master programme is a development of problem- and project-based learning, adapted to the virtual study environment. The MIL programme can be seen as a dialogue-oriented approach based on a social constructivist approach of networked learning (Dirckinck-Holmfeld & Jones, 2009, p. 261).

The virtual learning environment used at MIL contains asynchronous and synchronous communication facilities, file sharing, individual mailboxes and profiles, a who-is-online facility, etc., primarily based on a communication and collaboration system called FirstClass. In this system, student groups have their own virtual folders, which they are free to design and create, and where they can write, share, and organize their contributions. In addition to FirstClass, the students also use synchronous video meeting facilities (Adobe Connect, Google Hangout), peer-to-peer tools and web 2.0 facilities (Skype, Messenger, Google Docs,

Facebook, blogs), and tools to support project and course work (e.g. Camtasia for screen recording, Zotero for reference handling).

STUDENTS AS CO-DESIGNERS

As a result of the dialogue-oriented approach of the MIL programme, the design of the courses of the programme often involve students as active contributors and co-designers of activities in the learning environment. Such was the case of a third semester course at MIL on organisational learning and ICT. We will discuss elements of this course, as it took place in 2009. The course was based on virtual dialogues and collaboration, and it had a focus on meta-learning, meaning that the students were encouraged to continually reflect on the organisation of the course and the outcome of the virtual dialogues. The course took place over a period of two months, starting at an on-site seminar where students met for presentations, workshops, discussions, and group work, and followed by two months that were conducted through online discussions and project work in groups.

At the on-site seminar and the first week online, the students were asked to discuss which specific questions and themes they wanted to be reflected during the course. Drawing on the course literature and their own work practice, the students prepared specific questions to be discussed. A separate online discussion board was established for each question, and during two weeks each student contributed to an asynchronous discussion with his or her reflections on the various questions. Hereby the students explored the themes of the course through online dialogues.

Following these discussions, a small project work was organised, where students collaborated in groups. The specific questions, ie. the problems, to investigate in the projects were defined by the students. These projects were often carried out in relation to an organisation with which one of the students had closer contacts. Some groups organized their work with this task fully online, as the students participated from all over the country, while other groups combined online as well as physical meetings.

In the final week of the course, a shared discussion forum was created for the students to exchange their experiences, reflect on the methods they had applied, and build up knowledge relevant for their upcoming work on the final thesis of the programme, the master project. This final online discussion period was meant as an opportunity for the students to reflect on the course and their small project work: What insights did they achieve? What did they learn during the process? What would they eventually do otherwise next time in a similar situation?

During these final reflective discussions among the 2009 cohort, the 19 students added 116 contributions. One of the main themes discussed by the students dealt with collaboration processes in the students' groups. The students reflected on questions such as how to handle

working together online, and how to maintain an overview of the work, the deadlines and decisions; questions that are relevant also in relation to Lewin's work on group processes discussed above. A second main theme in the students' final online discussions also dealt with another topic discussed above, ie. the relation and interaction between students and supervisors online.

REFLECTING ON GROUP COLLABORATION PROCESSES

In relation to the students' discussions of group collaboration processes, one of the points discussed was how to handle the balance between on the one hand developing insights through the groups' oral discussions and on the other hand keeping these insights by producing written text. A student, whose group had found it difficult to find a direction for their work, explained that "we were not good in putting things down in writing, but on the other hand we were really good at talking and talking at our Skype meetings." (Male student, third semester, our translation). It is a well-known dilemma for many students to establish a practice where they as well talk and unfold ideas, but also capture these ideas in writing. The process of writing may be hard work, but it often contributes to clarifying the students' ideas. We see this dilemma as a parallel to Wenger's discussion of the importance of the interplay between participation and reification, between the momentary process of generating ideas and the long stretch of forming products and results (Wenger, 1998). Both processes are necessary parts of productive group collaboration.

Another meta-reflection developed by the students in relation to the discussions of group collaboration dealt with the relation between students and their supervisors. One student had the experience that students often "have a tendency to follow the guidelines from the supervision very strict," (student, third semester, our translation) and advocated that students need to be independent and reflexive when dealing with feedback. It is a balance for a supervisor between being outwardly pushing or patiently waiting. This balance is reflected in a contribution from a student who states how easy it is to fall into a 'traditional' student role, even though they 'should know better' from their daily work as teachers. This student writes that: "the world just looks different on the two sides of the fence: as a student, you need to know that it is okay, and that you are on the right track; as a supervisor, you are interested in being informed as precisely as possible what the student is writing and what you as supervisor can assist with. Furthermore, as a supervisor you are in contact with many students (...); while students have only one dedicated task that makes up a huge part of their life." (Female student, third semester, our translation). In this situation, the two positions of being a student and being a teacher/supervisor are so different, that even though they are held by the same person, it is difficult to transfer knowledge from one situation to the other. What seems logical in one situation may seem very different when situated otherwise (Andreasen & Nielsen, 2013).

DEVELOPING 'MASTER PROJECTS'

After dealing with student and supervisor roles and issues of collaboration in relation to the specific course, we will now turn to the students' final project work of the MIL programme, their work with the master projects. The master project serves as a conclusion to their two years of studying, and is often used as a chance to dive deeper into a specific problem or research question, which the students have a wish to investigate and potentially solve. The master project is thus driven by the students' own interests, as well in the starting point as during the project process. The participants have mutual responsibility for their joint learning process, and the collaboration among them is a long term process lasting the whole of a semester. Their work with the master project concludes with a written report of a relatively large size, often amounting to 60 or 100 pages (Mallow, 2001, p. 108).

At MIL the master project takes place during the Spring semester (February to June), but already at the face-to-face seminar in October the year before the students start a process of developing and negotiating which problems and research questions to focus on. A brainstorming event is organised, where proposals are lined up and students get a first idea of which themes could be relevant and which groups could be formed. Some students develop further on the themes from their small projects in the previous semesters; others move into new areas. These initial discussions are followed by online dialogues during the following months, where students are continually presenting potential topics for projects, and negotiating among them. At the January face-to-face seminar, the students decide regarding the choice of research questions, the final forming of participants individually or in groups takes place, and teachers are allocated as supervisors/facilitators for the projects.

Like projects in general, the master projects are oriented towards research questions that could occur in real life, and are often carried out in relation to or in interaction with concrete actors. When master projects are written in collaboration between two or three students, one of them will often be an "insider" in relation to the case or organisation being studied, while others may be "outsiders" (Dirckinck-Holmfeld et al., 2008, p. 178). The insider will often have a deeper knowledge of aspects of the research topic and will be able to facilitate access to contacts, places, etc. It may however be difficult to study practices you are involved in. Partly because of the involvement itself, partly because some practices may have become routines that you are unaware of. Therefore it may be difficult as an insider to establish the 'academic distance' necessary to study the case. Here other group members will as outsiders be able to challenge understandings and put forward critical puzzling questions. The possibilities of such a collaboration in a master project lie in the meeting of different perspectives, not by uncritically combining both, but through constantly being challenged in the students' assumptions and interpretations of their material.

CONCLUSIONS

We have presented and discussed four dimensions of a contemporary problem- and project-based learning approach. First, the focus on problems, which gives students an opportunity to explore problems through working with practical cases, often based in real-life. In the original PBL tradition the teacher has the responsibility of finding and presenting the problems to be dealt with. Working with problems are motivating for students, who are able to develop creativity and problem solving skills.

Secondly, project work was framed through going back to Kilpatrick's pioneer work in relation to the project method. Here focus is on students' own responsibility for developing and directing their meaningful work, and in this way gain motivation through a feeling of ownership and engagement.

Thirdly, we stressed collaboration and online work, since networked collaboration provides opportunities for students in flexible ways to connect to fellow students, interact with teachers and use varied forms of advanced technologies as learning resources. Collaboration through networked devices and the ability to engage in dialogues adds new dimensions to problem- and project-based learning.

Fourthly, a dialogic approach was pointed out, emphasizing that focusing on dialogue does not necessarily mean that creative learning environments should be established by fostering harmony and consensus. Rather, differences, variations of voices and viewpoints - even certain kinds of conflicts and tensions and the dialogues that they cause - may pave the way for learning and development.

We highlighted especially the history of problem- and project-based pedagogy in Denmark and the centrality of students' own responsibility of formulating the research questions to investigate. The roles of teachers as supervisors are to interchangeably apply different positions as lecturers, facilitators, and social mediators. For students to act and learn in complex knowledge-based societies, they need to reflect on their knowledge in relation to new situations that develop. Challenges are to organise their shared study processes, engage in dialogues, negotiate and find solutions to complex matters, as demonstrated through the examples from the MIL programme.

To work with projects is not always easy for students, but is something that has to be learned and practiced. In the beginning methodological aspects will be prominent, but eventually as students become more familiar with the method, the academic side will come sharper into focus. As discussed, participants in problem- and project-based learning processes may at times experience frustrations and collaborative work can be filled with tensions. On the one

hand authentic–learning can be the result of such situations, but on the other hand the obstacles should not be too high in order for students to handle the situations.

A critique raised in relation to problem- and project-based learning is that while students may achieve a fairly broad and methodologically oriented competence and may also be highly competent within the specific areas, on which they have focused in their projects, a worry is that they might lack a more general academic knowledge, i.e. the accumulated canon of established theories within their field. However, as Barrett and Moore argued, graduates from problem- and project-based learning institutions acquire competences that enable them to cope with real-life problems, get acquainted with new topics and help finding innovative ways of solving complex challenges and tasks.

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Using Web 2.0 Technology to Enhance, Scaffold and Assess Problem-Based Learning

Catherine Hack *

ABSTRACT

Web 2.0 technologies, such as social networks, wikis, blogs, and virtual worlds provide a platform for collaborative working, facilitating sharing of resources and joint document production. They can act as a stimulus to promote active learning and provide an engaging and interactive environment for students, and as such align with the philosophy of Problem-based Learning. Furthermore, Web 2.0 technologies can provide the tutor or facilitator with an opportunity to scaffold and asses the PBL process. However, whilst it is recognised that technology has an important role in enhancing each step of a PBL exercise, academic staff can be reluctant to use it. This paper provides some illustrative examples of the technologies that have been used to enhance, scaffold and assess PBL and their evaluation by distance learning and on-campus students at the University of Ulster. The benefits and limitations of using technology for both staff and students to support PBL are discussed.

It is widely recognised that technology has an important role in education. The almost universal adoption of Virtual learning Environments (VLE) by UK Universities (Browne Jenkins &Walker, 2006) in the early part of this decade was driven by a need to improve the efficiency and scalability of education, and has facilitated the delivery of flexible, self-paced education. By using a VLE to deliver core content, students could access material at a time that suited them, whilst releasing staff-student contact time for more valuable interactions. However the traditional VLE has primarily been used as a broadcast medium; replacing face-to-face didactic lectures with on-line lectures, despite the growing availability of more interactive web based tools both within the VLE environment and outside of it. In 2004, the

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term "Web 2.0" was used to encapsulate the way that the internet or "Web 1.0" could be used to promote user participation by sharing control of content, and providing richer user experiences (Anderson, 2007). An accepted definition of Web 2.0 is that it has become "*a group of technologies …..which facilitate a more socially connected Web where everyone is able to add to and edit the information space*" (Anderson, 2007, p.5). Web 2.0 has subsequently become shorthand for those services such as wikis, blogs, social networks, social bookmarking, podcasting and immersive worlds which instead of providing the user with static information allows them to add their own content. The potential of the Web 2.0 environment to facilitate collaborative and constructive learning has been demonstrated (Li *et al*, 2011, Stylianou *et al*, 2008 and Klamma *et al*, 2007); however it was recognised that the use of Web 2.0 based tools does not of itself promote collaborative knowledge production but requires that the teacher uses these tools to empower students to take control of their own learning (Tambouris, *et al* 2012). The characterisation of technology use through a 'practice perspective' by Dohn (2009) highlights the need for educationalists to consider how the technology is actually being used, by both the teacher and the student. Similarly, Leu *et al* (2004) concentrated on the skills or 'literacies' that are required to effectively use these tools and the tasks that can be accomplished using them:

> "The new literacies of the Internet and other ICTs include the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing information and communication technologies and contexts that continuously emerge in our world and influence all areas of our personal and professional lives. These new literacies allow us to use the Internet and other ICTs to identify important questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others." (p1572).

The five functions identified by Leu can be related to the learning outcomes which are frequently identified for Problem-based Learning (PB)L. PBL is a student-centred educational strategy that empowers students, promoting their engagement in constructive learning. PBL was originally developed in the 1960's to deliver the whole-curriculum in Medical Schools. Central to the original Medical School or McMaster model of PBL are student-centered discussions of problems in small groups (Barrows, 1996), There are no formal lectures; rather the tutor takes on a role as a facilitator, prompting with questions rather than providing information. Some forty years on PBL has been adopted and adapted by many different subject areas. Whilst the McMaster model was effective with highly motivated and experienced learners, it was recognised that less experienced students required more guidance in approaching PBL. The Maastricht or seven-step model was developed to provide students with a structure though which they could analyse the problem (De Graaff & Kolmos, 2003, Wood, 2003). In Table 1 the seven steps of the Maastricht model, have been mapped to the literacies identified by Leu, and some examples of how Web 2.0 technologies can be used to support and enhance PBL have been provided.

Some cohorts or individual students may require additional support in the PBL environment. Scaffolds can be used to help bridge the gaps between the current abilities of the students and the intended learning goals, and should be used when it is felt that the goals would be unachievable with unassisted efforts (Rosenshine & Meister, 1992, Kim & Hannafin, 2011).). Scaffolding can be an important element of the PBL process, depending on the maturity of the cohort, their previous experience in PBL and the complexity of the problem. By using Web 2.0 technologies the tutor can 'observe' the PBL process and provide support more efficiently and in a more directed manner. Table 1 includes examples of how Web 2.0 can be used to release further information, prompts or resources at various stages of the exercise or in response to particular issues.

This paper provides illustrative examples which demonstrate how technology has been used to support on-campus and distance learning (DL) students at the University of Ulster. In the first example a mind map was used to support on-campus students as they brainstorm and analyse a problem. The second case study demonstrates how a virtual world can be used to engage DL students in the social interactions that are central to PBL. The potential of wikis to support and scaffold independent learning and problem synthesis is demonstrated and the role of technology in assessment of PBL is examined. Finally, the barriers to the adoption of Web 2.0 technology are analysed and a strategy for improving staff engagement with Web 2.0 is proposed.

Seven-Step PBL Method	Leu Literacies	Web 2.0 Examples	Scaffolds
1. **Clarify Terms**: Identify all known and unknown concepts, words and phrases in the problem description	Locate information	• Collabulary: The group can develop a collective vocabulary of terms and concepts needed to analyse the problem • Glossary: Develop a formal list of definitions, which can be shared within the wiki.	• Provide glossary • Encourage students to create their own glossary within their project workspace. • Prompt students to provide source of definition
2. **Define the Problem**: What are the underlying issues, concepts, phenomena that need to be understood in order to solve the problem 3. **Analyse the Problem**: Brainstorm the problem to generate ideas and hypothesis. 4. **Review collated ideas and Information**: Construct viable hypotheses 5. **Formulate Learning Objectives**	Identify important questions Critically evaluate information	• Mindmapping:promote brainstorming and creative thinking though visualising the problem. • Social networks: group communication • Wikis: Webpages produced and edited by the group	• Provision of mind mapping tool can provide a prompt to structure and organise ideas and classify knowledge or it can be provided with predefined prompts. • Prompting questions can be added to wiki/ social network sites • Prompt students to identify personal skills and knowledge • Provide links to resources • Provide procedural assistance • Provide pages with title prompts (wiki)
6. **Independent Study:** To fill gaps in knowledge and meet learning objectives	Locate information Synthesize Information Dissemniate Information	• Develop folksonomy to tag information for sharing within group. • Provide updates to group through the wiki, share resources and defintitions through creation of collabulary or formal glossary on wiki • Blogs: Keep a log of individual opinion, information, and/or diary entries thoughout the period of independent study. This can be shared with the group, the tutor and made avalaible for comments, or kept private.	• Tutor can comment on blogs/wikis to help diagnose misconceptions and promote evaluation of multiple perspectives
7. **Synthesis and Reporting:** Share findings with the group to identify viable solutions to problem, or identify further learning objectives	Dissemniate Information	• Use wiki to publish and disseminate findings to group/ tutor.	• Prompting questions: What is presentation trying to achieve? Who is the target audience? • Prompt with examples of alternative reporting formats

Table 1: The new literacies that can be afforded by Web 2.0 technology and how they can be aligned to the steps of the PBL process, with illustrative examples of the way in which Web 2.0 technology that can be used to enhance and scaffold PBL.

ILLUSTRATIVE EXAMPLE 1: USING MIND MAPPING TOOLS FOR STEPS 1-4 OF THE PBL PROCESS

Concept or mind mapping was first suggested for use in organising and representing knowledge by Novak in the early 1980's (Novak & Cañas, 2006); it has been since used in a wide range of subjects and for different learning tasks and teaching methods (Daley & Torre, 2010) including problem-based learning (Alamro & Schofield,2012 and Addae *et al*, 2012) . A number of open source mind mapping tools are available including Freemind® and X-mind®. These tools encourage students to structure the problem, integrate current knowledge and identify areas where they need to conduct research. They can also be used to identify skills within the group and assign tasks. In X-mind®, the mind map can be shared on-line, allowing members to update the group on their activities. The following example shows how a mind map was used to support postgraduate biotechnology students in the initial brainstorming of the PBL problem.

DELIVERING BIOINFORMATICS TO ON-CAMPUS POSTGRADUATE BIOTECHNOLOGY STUDENTS: PEDAGOGICAL BACKGROUND

Problem-based learning (PBL) has been used to deliver bioinformatics to postgraduate students on a one year Masters programme in Biotechnology for over five years, as part of a module in Molecular Biotechnology. It was envisaged that at the end of this period students would be able to identify and implement appropriate computing, analytical or statistical solutions to solve problems in bioinformatics/systems biology and molecular biotechnology. A rich resource of challenging scenarios for PBL scenarios is the abstract databases for publicly funded research projects; several scenarios for this course have been developed from abstracts available on the Biotechnology and Biological Sciences Research Council (BBSRC) website[1]. A typical example of a scenario extracted from a grant application is explored in figures 1 and 3. It speculates on the presence of key enzymes required for the degradation of organophosphonates and requires that the students identify the potential degradation pathways and the associated enzymes, and then identify and search the appropriate databases. They are also prompted to consider the validity of *in silico* evidence. The students worked in groups of 5-6, the exercise included 2 x 2 hour classroom sessions supervised by a floating facilitator. The students had 3 weeks to complete the task.

In this example the group identified the software and databases that thought may be relevant, the terms that required definition, and the reaction kinetics (Figure 1). Summing up at the end of the first session was important in providing students with reassurance and for ensuring the pedagogical aim was met, without restricting independent and self-directed learning.

[1] http://www.bbsrc.ac.uk/pa/grants/default.aspx).

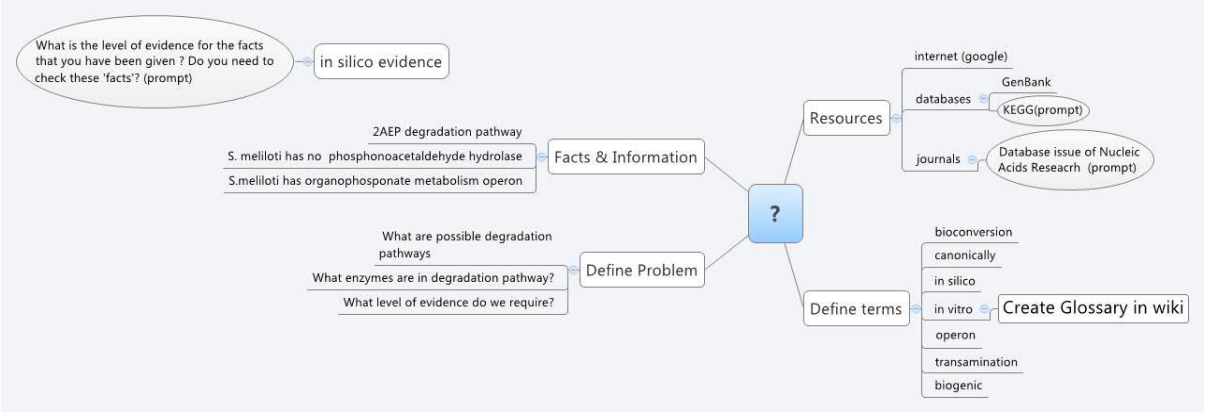

Figure 1: Mind mapping tools such as X-mind® can be used during steps 1-4 of the PBL process to develop a schema allowing students to integrate prior knowledge, identify key questions and resources, and assign tasks.

ILLUSTRATIVE EXAMPLE 2: USING IMMERSIVE WORLDS TO PROMOTE SOCIAL INTERACTION DURING STEPS 1-4 OF THE PBL PROCESS

Immersive or virtual worlds (VW) in which the residents can explore the three dimensional environment and interact with others, have the potential to enrich student learning environments, providing opportunities for engagement in challenging learning tasks and to encourage and enhance interaction and dialogue by students (Monahan, McArdle & Bertolotto, 2008). The ability to hold synchronous discussions with a spatial dimension offers the best opportunity to replicate and enhance face-to-face PBL activities in the digital world. A virtual campus, BioSim, was developed for our DL students, which had a number of bespoke classrooms designed for specific learning activities, including an E-library which contained additional resources and a problem-based learning room.

DELIVERING BIOETHICS VIA DISTANCE LEARNING POSTGRADUATE LIFE AND HEALTH SCIENCE STUDENTS: PEDAGOGICAL BACKGROUND

BioSim was used to deliver bioethics to a group of post-graduate DL students. The aim of the module was to encourage students to examine the ethical issues raised by advances in the life and health sciences. Central to the module is the ability to construct and defend evidenced-based arguments. Three different scenarios were used during the module:

1. 'Enviropig'- the development of genetically modified pigs that have a reduced environmental impact;
2. Should egg donors and sperm donor be paid the same?
3. Should the research community have access to anonymised medical data?

For each scenario the trigger comprised either of a single video or a series of short videos providing alternative stakeholder perspectives, which were released at stages during the exercise. The videos were screened in the virtual world from public resources such as Youtube[2] and the BBC iPlayer[3] (available only in the UK). The students, working in groups of 6-8 watched the video triggers together 'in-world' and then discussed the issues arising. A series of slides were available as prompts to provide some focus and structure to the discussion; encouraging them to define the problem and formulate their learning objectives. Additional resources were also provided in the E-Library. (Figures 2(a), (b) and (c)). Having completed stages 1-4 in the virtual world, a wiki was then used to support independent study and as a workspace to develop the problem solution over the following two weeks.

Figure 2: PBL in a virtual world.

Figure 2(a) Students watch a video clip trigger

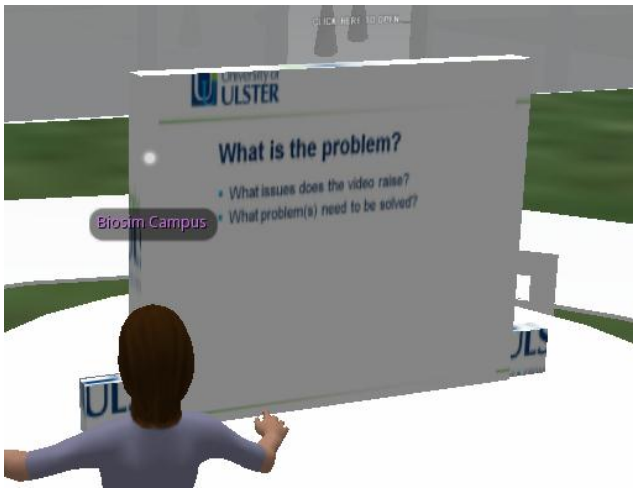

Figure 2(b) Slides provided to scaffold the PBL process

[2] http://www.youtube.com
[3] http://www.bbc.co.uk/iplayer

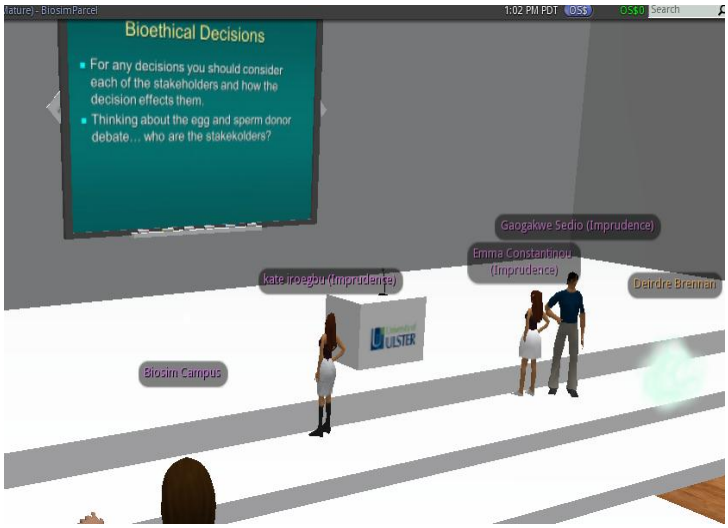

Figure 2(c) 3 students are delegated to access further information to inform the problem construction.

A questionnaire was developed which asked students how well they agreed or disagreed with twelve statements relating to three areas: skill development (communication and presenting ethical arguments), engagement with the module and subject knowledge. 19 students responded to the questionnaire and the responses were collated and shown in Figure 3. The majority of students agreed that the virtual world engaged them with their learning and helped them develop their communication skills. There were six positive responses in the 'free-text section' regarding the use of BioSim, typical examples were:

> "Really enjoyed the video discussions. The virtual world interaction was particularly good for this type of exercise" and "I believe that using avatars would help to give all group work members the confidence to engage more fully with their colleagues."

It was recognized that there was a learning curve for both staff and students in using the technology, and there were two negative comments from students who struggled with the technology:

> "I enjoyed the Biosim discussions even though there were many teething problems"and "Biosim problems need to be sorted".

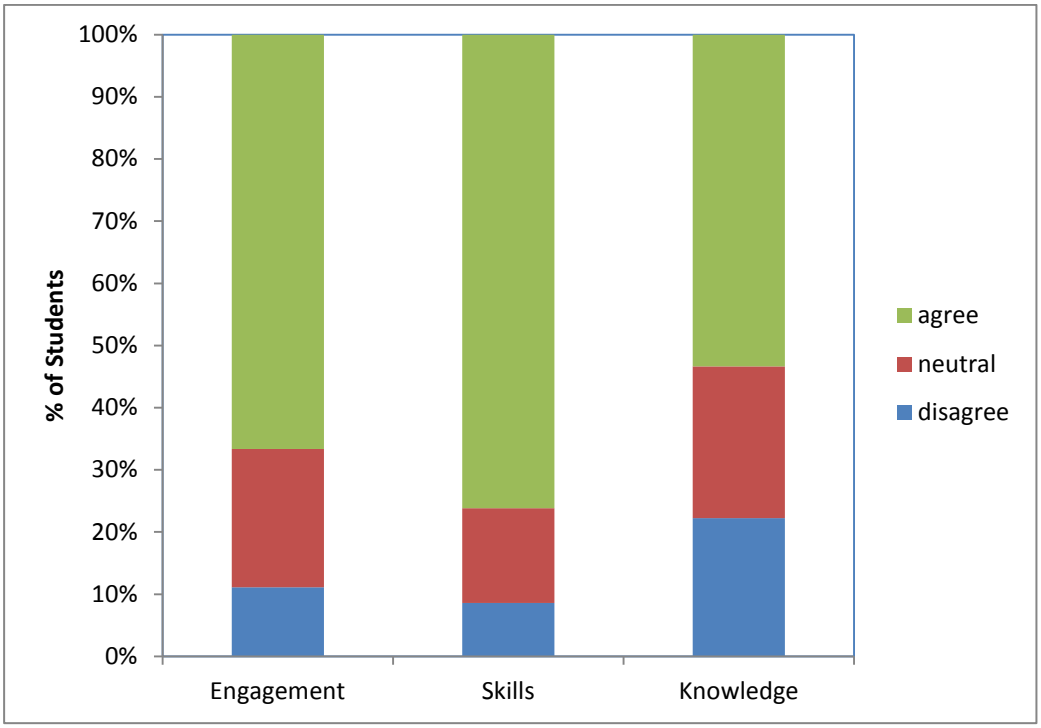

Figure 3: Student Feedback on the use of the BioSim virtual campus to engage students with their learning, develop subject knowledge and communication skills.

ILLUSTRATIVE EXAMPLE 3: USING A WIKI AS A WORK-SPACE DURING THE PBL PROCESS

A wiki is simply a piece of software that allows rapid creation, editing and publishing of a web page, possibly the most well-known example is wikipedia which is based on user-provided definitions. By providing each member of a group with read/write privileges to a wiki, it can be used as a project work space through which the group can collaborate to construct the solution to a problem. Internal and external links allow group members to share resources and provide cross-references to other contributions. Each group member can tag their contribution, which has benefits for both the student and the tutor. The student contributes to the group knowing that their individual contribution is recognised, whilst the tutor can monitor the PBL process without being actively visible on the wiki. Other evidence has indicated that the use of a wiki promotes interactivity and a sense of community within the learners (Dlouha & Dlouhy, 2009). This has obvious benefits for DL programmes, where students can feel isolated, wikis have also been used in work-based learning (Moteleb & Durrant, 2009), where they can support students on placement, helping them stay ‘connected’ to the university and their peer group.

At the University of Ulster, the enterprise wiki, Confluence® is embedded within the VLE. An enterprise wiki combines a wiki with communication tools, such as blogs and RSS feeds. Embedding the wiki within the VLE provides security (so it can be used for projects involving confidential data), plus easy access, and a familiar environment for staff and students.

The wiki was used as students undertook independent study in the previous two examples. They could provide regular updates to the wiki, and share resources with the group. Figure 4 shows a screenshot of the wiki which was used to capture the individual study carried out by the biotechnology students. The wiki identifies the pages that the students created in the first stages of independent study which includes a glossary and identification of further resources they planned to explore. Each contribution was tagged with the author's name, making it easy for the tutor to monitor the PBL process. Finally the wiki could be used as a reporting mechanism for the project.

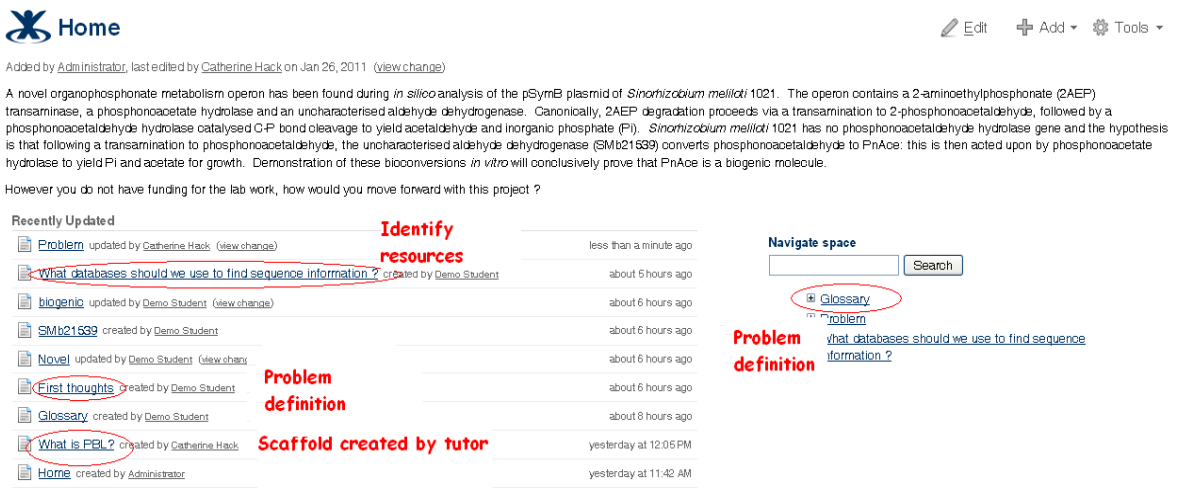

Figure 4: Screenshot from a wiki during the first stages of independent study in the PBL exercise

SCAFFOLDS

In these problems the tutor could use both the mind map and the wiki to scaffold the problem. Typical prompting questions have been identified on the mind map and the wiki (Figures 1 and 4). For less mature cohorts the mind map can be provided with initial prompting questions Such as "What is the problem?", "What do you know about the problem?" What resources will help you solve the problem? , and "What do you need to do to solve the problem? At the end of each session, the mind map can be shared with the tutor or facilitator for reassurance or guidance on identifying the learning objectives. As students use the wiki to construct the solution to the problem, the tutor can observe the process and provide appropriate support and links to suggested resources as required without compromising one of

the central goals of PBL to encourage students to become independent and self-directed learners.

ILLUSTRATIVE EXAMPLE 4: ASSESSMENT IN PBL

PBL aims to develop higher cognitive and transferrable skills, as well to improve long-term knowledge retention; however assessment in PBL activities is often not matched to addressing these outcomes (Walker and Leary, 2009). Self and peer-assessment are important to meeting the learning goals of PBL. At Ulster we have used webPA[4] , an on-line tool which can be used for peer and self-assessment. It is open source software developed by a consortium led by Loughborough University through JISC[5] funding. The software allows students to assess both their own contribution and that of each team member to a project. This means that whilst the tutor has marked the product of the PBL exercise, such as a single report from the group, each student will receive an individual mark based on their contribution to the project, as assessed by the team members. Students can be engaged with the whole assessment process including setting the criteria, and provided an opportunity to evaluate the whole PBL process, rather than just the end product.

INTRODUCTION TO BIOINFORMATICS FOR FINAL YEAR LIFE SCIENCE STUDENTS: PEDAGOGICAL BACKGROUND

Problem based learning (PBL) was used to deliver bioinformatics education to final year biomedical science and pharmacology students, as part of a module in Human and Molecular Genetics. It was envisaged that at the end of this period all students would be able to take a DNA sequence, and identify the following: Which gene it came from? Which protein it coded for? What was the protein function? There was also the opportunity to explore the effect of the mutation, and to consider issues such as probability and risk. Furthermore the PBL exercise provides the opportunity to explore the ethical issues raised by genetic screening. The students were provided with the following problem:

> "You are working in a Genetic Screening Laboratory which analyses DNA. You have been provided with a sample of foetal DNA. Please prepare for a meeting with the prospective parents".

The students (n~ 50) were randomly assigned to groups of ~6-8. The exercise included 2 classroom sessions, plus a final role play and review session. The students had 3 weeks to complete the task, which involved a significant amount of independent study and group work. The anonymous assessment process encouraged students to provide an honest mark,

[4] http://webpaproject.lboro.ac.uk/
[5] http://www.jisc.ac.uk

evidenced by a wide distribution of marks both within the group and across the categories (Figure 4).

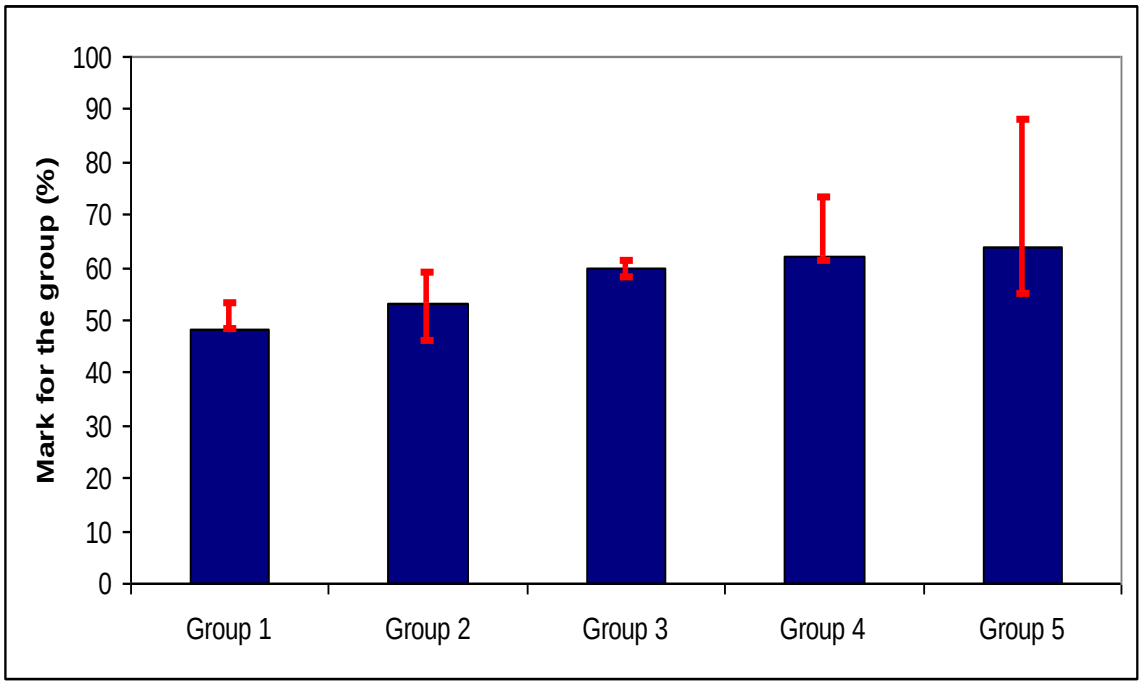

Figure 5: Distribution of group marks for PBL activity. The solid bar is the mark that was awarded for the final submission produced by the group. The e bars (|) indicate the maximum and the minimum mark achieved by individual students in the group.

However whilst it is acknowledged that peer and self-assessment are in and of themselves important higher-order thinking skills, students are not always competent at assessment and several 'rating' errors have been identified (Sluijsmans *et al* 2001). Other evidence has indicated that peer assessment in PBL exercises can create tension within the group, and harm the intended collaborative nature of the exercise (Papinczak, Young & Groves, 2007). An alternative is to use the wiki for assessment of the PBL process. Each contribution to the wiki is automatically tagged, enabling the identification of individual submission, facilitating the assessment of individual group members at various stages of the PBL exercise.

NON-ADOPTION OF TECHNOLOGY

An internal audit to identify the barriers to the use of Web 2.0 technology at the University of Ulster received almost 180 (24%) responses from academic staff across all faculties. Over 90% of respondents used the VLE to deliver information to students, but the numbers using more interactive forums that were embedded within the VLE were much lower: discussion boards (39%), wikis (12%) or blogs (10%). This data supports a previous study (Ward *et al*, 2009) of staff delivering health care education in higher education institutions. Over 80% used technologies associated with the VLE, whilst less than half used Web 2.0 technologies

such as blogs (44%) and wikis (32%) The response rate to the Ward (2009) survey was approximately one quarter of those invited, similar to the response rate in the Ulster study; accepting that staff interested in using technology for teaching may be more inclined to respond to the survey, the actual use of Web 2.0 technology might well be lower than that reported. The Ulster survey was promoted as an 'Audit to identify the barriers to using technology' and may have prompted a higher response rate from non-adopters, resulting in a higher number of respondents (~1/3) indicating that they had no intention of using Web 2.0 technology, than observed in the Ward study.

Both surveys indicated that the main barrier to the use of technologies was an unwillingness to invest time in developing skills in this area, without a full appreciation of the benefits of the technology. Other issues raised were relating to cyber security, the requirement for monitoring forums, and concerns about the barriers between social and professional networks. The most often cited reasons for the non-adoption of new technologies include the lack of time / heavy workload and the lack of IT skills or support. The adoption of the VLE was driven, in part, by institutional demands for efficient course delivery, however the incentives for adopting other technologies are less obvious, and staff are concerned about investing time in a technology that may rapidly become obsolete. Furthermore staff may be nervous about introducing technology, as they can feel that the new generation of students, the 'digital natives', are much more familiar with the technology (Prensky,2001). Other concerns reflect issues with security, on-line safety, cyber bullying and uncertainties over the boundaries between social and professional networks.

At Ulster we have developed an on-line Community of Practice for academic staff, which allows staff to use Web 2.0 technology in a professional arena, and increase their knowledge of the potential benefits as well as their own aptitude and skills of the technology. This approach is in-line with recommendations from Amundsen & Wilson (2012) who suggested that interventions aimed at developing mastery of a new teaching method should place emphasis on learning about a particular teaching method and how to use it and design training such that it models the method being taught. Engagement with both the technology and their peers via the Community of Practice will provide staff with experience of the learning environment that students will encounter, and it is hoped this will provide staff with the confidence to use Web 2.0 in their own teaching.

CONCLUSIONS

As the provision of distance learning programmes increases to meet the growing demand for flexible learning and continuing professional development; effective use of Web 2.0 technology can improve engagement for DL students and provide opportunities for the social interactions and collaboration required for effective learning. However it is argued that Web 2.0 technology, used appropriately can provides additional benefits, supporting and promoting

collaborative learning, facilitating scaffolding and providing mechanisms for self and peer-assessment, and as such should be offered to both on-campus and DL students. Thus, whilst PBL has been traditionally characterised by the social interactions that occur during group working and the central role of the facilitator, our experience has indicated that Web 2.0 technology can enhance the PBL experience for on-campus students. The alignment of Web 2.0 with the goals of PBL, has been recognised and studies have reported the use of wikis to share resources (Varga-Atkins *et al*, 2010) and social network sites to communicate (Drohan & Widger, 2008). By incorporating technology into the PBL process, students will be given the opportunity to develop their skills in these literacies, and enhance their exploration and understanding of the problem, creating a virtuous circle of skills and knowledge. One of the key features of Web 2.0 technologies is their collaborative nature, and as such they lend themselves to PBL learning environments where no one member of a group, including the tutor or facilitator, may be considered an expert. Many other aspects of Web 2.0 conform to the learning goals of PBL; facilitating sharing of resources and joint document production, furthermore they can promote active learning and provide a platform for the development or construction of knowledge. Additionally, basing the PBL process within the on-line environment can facilitate the provision of multimedia triggers, and promote students to consider the medium through which they should disseminate the problem outcomes.

As Web 2.0 technologies mature, and become embedded in VLE's or other University supported information technology such as a PDP system, the boundaries between wiki's, blogs, E-portfolio's, discussion boards, and chat rooms may become less distinct. The effect this has on uptake and the way that these tools are used has yet to be seen. Evidence has indicated that students wish to keep their social networks separate from their professional or academic life (Ward *et al*, 2009); however, this does not preclude having a social interface and an academic interface. In PBL it is expected that students identify appropriate resources to solve a problem, this should include the use of appropriate information and communication technologies. The embedding of Web 2.0 within the University IT infrastructure should provide the opportunity for a less prescriptive approach to the use of technology, allowing students to identify the most appropriate tools for the task. Educational scholarship can be transformed with Web 2.0, and providing further opportunities for staff to develop their skills and gain an appreciation of the benefits will reduce the barriers to the adoption of the technology.

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Problem-based Universal Design for Learning in Technical Communication and Rhetoric Instruction

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ABSTRACT

It is crucial for Tech Comm instructors to address challenges of audience within the artificial environment of classroom instruction. Without a distinct and specific audience, course content often remains theoretical and abstract, and students struggle both to connect the unknown to the known, and to generate meaningful and effective communication. As a consequence, teachers often ask students to create "authentic" audiences in order to provide a tangible anchor for learning. Truly authentic audiences, however, are increasingly mixed, composed of constituents who have disparate interests and needs that must be addressed with multiple sophisticated appeals, arguments, and modalities. Theories of Problem-Based Learning (PBL) and Universal Design for Learning (UDL) can be used to embrace these complexities meaningfully, strengthening students' opportunities for learning through scaffolded instruction and flexible course design.

INTRODUCTION

As on-site and on-line classroom dynamics change in the digital age, it is crucial now more than ever for instructors to address challenges of audience within the artificial environment of classroom instruction. But without a distinct and specific audience, course content often

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remains theoretical and abstract, and students struggle to connect the unknown to the known in order to generate meaningful and effective communication. As a consequence, teachers often ask students to create "authentic" audiences in order to provide a tangible anchor for learning. Truly authentic audiences, however, are increasingly mixed, composed of constituents who have disparate interests and needs that must be addressed with multiple sophisticated appeals, arguments, and modalities. A typical technical communication document on its own may have to address the expert and the non-expert as well as acknowledge the primary, secondary, and tertiary readers of the document. In a traditional classroom environment, this challenge is often augmented by the wide range of student strengths and weaknesses, and the rigidity of such traditional environments, both pedagogical and physical, makes effective adaptation difficult.

Theories of Problem-Based Learning (PBL) and Universal Design for Learning (UDL) have both been offered as means of embracing these complexities meaningfully, strengthening students' opportunities for learning through scaffolded instruction and flexible course design. A central problem, however, is that mere application of new theoretical approaches to an otherwise traditionally structured class tends to produce few substantial gains (Edyburn 2010). Furthermore, the constructive power of each approach is generally seen in isolation from the other.

Lunsford and Ede (1984) explored the role of audience in pedagogy a number of decades ago, suggesting that to *address* an audience is pedagogically useful, but to go further and truly *invoke* an audience deepens learning. PBL is especially helpful to invoke an audience. While there are many interpretations of Problem-Based Learning, according to leading educational theorists de Graaff and Kolmos (2003), PBL:

1) addresses a specific problem;
2) relies on self-guided learning;
3) includes experiential learning;
4) involves activity-based learning, including research;
5) involves inter-disciplinary learning;
6) includes exemplary practice; and
7) is principally group-based. (p. 658)

Hmelo-Silver (2004) defines PBL as “focused, experiential learning organized around the investigation, explanation, and resolution of meaningful problems” (p. 236). Because PBL is inherently student-centered, it has broad potential for classroom application. While it requires greater student investment in learning, its audience-centered approach offers profound educational returns in part by addressing the reality of the diverse classroom audience, and using the rich variety of students and student learning styles to address the comparable

complexity of a real audience in need of real solutions. Without the instructor's use of realia, it is all the more difficult to motivate learners.

In contrast to PBL, UDL, grounded in the 1997 reauthorization of the *Individuals with Disabilities Act* (Edyburn, 2010), has long been more a construct of theory. According to the Center for Applied Special Technology (CAST), because students have different perceptual and cognitive strengths, as well as different experience with various technologies and discourse communities, students must be taught how to organize content and use it in their own ways. No two brains work the same, thus, there is no one best way for a teacher to present information; and there is no one best way for students to work toward transferring knowledge. UDL refers to this as a recognition network, or the "what" of learning. UDL strategic networks include the "how" of learning, and UDL affective networks include the "why" of learning. Any given problem requires recognizing, strategizing, and affecting multiple ways to work in groups to solve problems. Because students value different extrinsic rewards, and because they develop intrinsic motivation in different ways, multiple means of engagement to solve problems through making connections to course content in different ways is essential (Rose & Gravel, 2012).

Application of this approach has long been problematic, and thus Edyburn's "ten propositions for new directions for the second decade UDL" are of great interest. In particular, he points out that as the theory moves from the advocacy phase to the accommodation phase—and awaits the promise of the final stage of accessibility—"many early disciples of UDL find themselves struggling to achieve the potential of UDL within current limitations of instructional design and product development" (p. 36). To combat this he offers 10 new directions for the implementation of UDL:

1) UD in education is fundamentally different than UD in the built environment;
2) UDL is fundamentally about proactively valuing diversity;
3) UDL is ultimately about design;
4) UDL for learning is not just good teaching;
5) UDL for learning does not occur naturally;
6) UDL requires implementation of technology;
7) UDL is not assistive technology;
8) UDL's primary and secondary impact must be measured;
9) UDL must be evaluated on the basis of enhanced student performance; and
10) UDL is much more complex than we originally thought. (pp. 36-40)

A table comparison between the two theories highlights how the two diverge.

Traits of PBL	**Traits of UDL**
addresses a specific problem	focuses on design
relies on self-guided learning	must be evaluated on the basis of enhanced student performance
includes experiential learning	Learning does not occur naturally UD in education is fundamentally different than UD in the built environment
involves activity-based learning, including research	requires technology for successful implementation
involves inter-disciplinary learning	proactively values diversity
includes exemplary practice	requires measurement of primary and secondary impact
is principally group-based	is not assistive technology

Figure 1: PBL and UDL Comparison Chart

Let's cogitate on the two-tiered approach of PBL, considering the students as a real and complex instructional audience as well as asking the students to address another real and complex audience. It can be argued that a course that fully embraces the spirit of PBL will likewise manifest the goals of UDL. The nature of PBL demands that students connect learning directly to real situations through invoking authentic audiences and applying lessons to real contexts in highly motivating ways. When such an approach is taken, and the traditional pedagogical and physical structures of the classroom are set aside, the result is an environment that accords with UDL's flexible approaches to recognizing, engaging, and organizing problems in the classroom. It is our assertion, then, that the key goals of UDL are met by a PBL course occurring in the flexible environment of a media laboratory. In effect, PBL that embraces the profound structural changes demanded by UDL offers the pedagogical space in which students are transformed into genuine authors of their education, a transformation that is enhanced by the physical space – the *third space* of the media lab.

It must be emphasized that true implementation of UDL through PBL requires pedagogical re-envisioning, profoundly altering the traditional roles of instructor, student, syllabus, and classroom. Such repositioning demands a similar change in the space and tools of the classroom, but the authors of this article propose that this is relevant to a changing paradigm

in education, a need to shift to more dynamic, real-world mediums. This pedagogical repositioning and melding of PBL and UDL can also refresh classroom dynamics, and rewards for students, teachers, and content are well worth the challenge. A recent graduate course in New Media Rhetoric (NMR) conducted as part of Texas Tech University's Technical Communication and Rhetoric (TCR) doctoral program supports this claim. In this course and approach, the classroom instructor provided multiple means of representation as well as a meaningful forum for students, which afforded avenues of student engagement in order to facilitate a meaningful problem-based UDL experience. In effect, the implementation of UDL through PBL proved within the environment of media laboratory served to enrich those involved in NMR to an extent that it is their belief that this can be applied effectively in other courses.

BACKGROUND

Students in Texas Tech University's Technical Communication & Rhetoric online doctoral program meet onsite for a two-week, mandatory residency every summer. During this time, students take one of three courses: Usability Testing, Document Design, or New Media/Rhetoric. All three courses use PBL and UDL to explore theoretical and practical complexities of course material through providing help and support to non-profit organizations. For NMR, this approach requires students to create a suite of materials that can range from websites, instructional videos, and social media campaigns. The client for summer 2012 was the Texas Manuscripts Cultures (TxMSC) project, a digital humanities project that aims to preserve and reinvigorate Texas heritage by obtaining letters, photos, and other memorabilia dating up to 1950 and scanning and transcribing these materials into a searchable online database. TxMSC requires a large donation of time and/or materials, as ideally materials are scanned and transcribed by project participants. The class decided to produce compelling promotionals and directions. Specifically, while referencing principles of crowdsourcing, modularity, and relational bibliographic databases, the NMR class worked to create a promotional video, several viral videos, a series of "How-To" instructional pages, and a report on the research conducted on these TxMSC materials and similar digital humanities project approaches. Thus, this service-learning class created and produced five deliverables: three videos, a streamlined single webpage illustrated with step-by-step photos that show TxMSC users how to upload documents, and an analysis with suggestions for the advantageous use of social media.

Problems presented by the project required flexible curriculum course design. Obstacles ranged from client expectations to time constraints to interpersonal conflicts. However, by using UDL with PBL and radically re-visioning the course, students were able to synthesize applicable knowledge obtained through self-directed learning and intrinsic motivation to meet the client's needs at the same time they fulfilled the course goals and addressed each key principle of PBL. This structure thus also adhered to the principles of UDL, which demands a

course that "provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills; and reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students" (Edyburn, 2010, p. 2). The audience "specifically" in mind for NMR's suite of products was the Texan, a formidably large demographic that considers different ages as well as multiple ethnicities with multiple languages. The NMR team worked within this framework as they designed and delivered products for their wider clientele base, a more usable website design, embedded marketing videos, and streamlined directions for participating in the project. NMR designed these products with the widest possible range of function and usability through user-friendly technologies.

APPLICATION OF THE SEVEN PBL PRINCIPLES

De Graaff and Kolmos's (2003) seven features of PBL provide a useful set of detailed guidelines. They state the first step of PBL is to address a specific problem (p. 658). Sometimes simply locating and identifying the problem itself is challenging. For instance, while it was clear that TxMSC required a suite of new media materials to promote their project and instruct potential participants, the NMR class interpreted the "problem" as one larger than just the delivery of videos and other materials to the client. Instead, the NMR students interpreted the problem as rhetorical, one where the audience is mixed and considerably diverse, finding motivation to contribute to the database from a divergent set of reasons. The TxMSC audience consists of "Texans" who possess heritage documents dating before 1950, but who are these Texans, what are their social and economic backgrounds, and how can NMR products foster and promote participation? Consequently, the NMR class framed the problem to create an appeal to the clients' stated audience of donors, educators, middle school students, and civic-minded individuals with an interest in manuscripts. In other words, the NMR class needed to appeal to and persuade those who could donate *materials* and those who could donate *time* to transcribe materials. Additionally, the client, another professor within the TCR program, was also considered a member of the audience. This is often the case with PBL and service-learning projects: The relationship between the client and the teacher and the students is often complex.

A second primary principle of PBL is that effective approaches enable students to heavily self-guide their learning. When it came to the use of video editing, sound recording, digital photography, and many other technological skills that were required to complete artifact production for TxMSC, a broad range of technological expertise was needed, from researching appropriate photographs for the website to editing to creating voiceovers to writing copy. Some in the class could be classified as experts on a given system or tool, while others had fewer technological skills in specific areas. Rather than let these discrepancies between learners' skills slow the team down, students became motivated to optimize these dynamics to maximize learning and quality project component completion. Rather than rely

on a teacher to explain how a program or a device worked, for instance, students sought out this information themselves, intrinsically. Doing so represents not just the second feature of de Graaff and Kolmos's steps, but also the third and fourth: PBL includes experiential learning and involves activity-based learning, including research.

This approach aligns well with the effects of well-implemented UDL instruction. First, the bottom-up nature of the PBL design innately values diversity, and thus also accords well with Edyburn's views. In the traditional classroom homogeneity is the goal: students are to be educated toward a common set of knowledge and skills, with uniformity of acquisition the goal, and diversity of initial knowledge an obstacle to be overcome. In the PBL-centered classroom, the diversity of the team becomes an asset rather than an obstacle, as varied strengths of students are intrinsic to the construction of the project and the diffusion of knowledge throughout the group. As de Graaff and Kolmos (2003) note, "within the same work environment theme, the group can actually work with widely different disciplines and subject methods" (p. 660).

To that end, the two-week experience provided the perfect arena for experiential learning, de Graaff and Kolmos's third PBL component. Liaising with clients, proposing countless product ideas, editing digital footage, collaborating on an entire real-world suite of digital media: For many team members, it was their first time to encounter any of these tasks, and it was oftentimes within a confounding situation. Touching base with the class professor, bouncing ideas off of team members via the team Facebook page, and conducting discount usability tests enhanced the experience and provided solid grounds for members to build upon necessary schemata. Moreover, as will be covered more extensively later in this paper, students discussed theory and practices on a daily basis with their professor within TTU's Multiliteracy Lab (MuLL) setting and were able to immediately experiment and apply what was learned. Impractical solutions were quickly discarded as the team built upon more solid foundations of theory and practice.

Activity-based learning, de Graaff and Kolmos's fourth PBL component, was very real-world for the team: frenetic, dynamic, and inspired. Various strengths of individual team members became more apparent. Some were more comfortable with leadership duties while others showed prowess at organizing deliverables and firming realistic deadlines. Still others worked well behind the scenes, perfecting the ideas that had been accepted and honing final products. The multiple centers of activity, as well as their ultimate convergence on a common set of final products, is central to UDL, and was facilitated not merely by the pedagogical structure of the course, but by the physical environment of the MuLL, which itself offers the same flexibility and potential for customized restructuring as does UDL itself. Team members experienced various stages of each process as well. The deliverables themselves comprised the activities, and the team learned by doing, developing dexterity at jumping into various stages of processes, oftentimes assisting whenever a new need arose. This also reflects the

world outside of the MuLL's walls, since processes in professional situations can quickly start, stall, and stop, and overall team function necessitates individual flexibility and efficiency. This was experiential learning compressed into two concentrated weeks, and every minute counted.

A fifth principle of PBL is that it involves inter-disciplinary learning. While there were two Texans within the NMR student team, the learning curve was quite steep; for instance, questions about the specific meaning of "Texas heritage," what makes an effective sound bite, which thematic approaches would attract the largest number of possible users, and which types of background music would appeal to a wider base of Texan website users were considered, discussed, and debated. Problem-based UDL involves trial and error, and the team tested all of its media type usage multiple times in order to hone its set of deliverables before the final due date. The work was collaborative and interdisciplinary, demanding a variety of literacies, which made the differing skill sets of the team members a vital asset rather than an instructional liability.

PBL also includes exemplary practice. Incorporating Lev Manovich's (2001) principles of new media from *The Language of New Media* within a problem-based UDL framework, the NMR team worked to design rhetorically-sound artifacts for the client while embedding these new media definitions and concepts:

1. *Numerical representation*: Media can be expressed in numerical representation.
2. *Modularity*: There are components to every NMR objective, which will build upon one another.
3. *Automation*: Replication can be produced automatically. There is no need to code HTML content if NMR content has some sort of replicability.
4. *Variability*: Information is exchangeable. Different content can be triangulated.
5. *Transcoding*: There are two layers to every NMR product: the digital layer and the cultural layer. It is crucial to learn how one layer exonerates the other. (Manovich)

Incorporating Manovich's five principles provided a strategy, a tacit agreement, in order to ensure detailed objectives were met and on par with student benefits. Team members learned to execute professional products efficiently, to cope with failure, and to provide alternative solutions in order to meet rigorous deadlines and maintain quality of the client's original vision. The team comprised of students whose ultimate goal was to learn theory, transfer specific knowledge, and apply methods within a flexible environment that demanded high achievement. After all, what happens in real-world situations when the client expectations are not met? The TxMSC project was the vessel used to reach this goal, and after the two weeks finished, team members could apply this new knowledge to their own academic and professional goals.

The assessment inherent in this aspect of PBL is also inherently aligned with UDL principles. As Edyburn (2010) states, "UDL outcome measurement needs to focus on the benefits that result from access and sustained engagement: expertise and expert performance" (p. 40). PBL is "expert" in nature, particularly within a genuinely PBL-centered course such as NMR, where the client/team interaction and the project delivery serve as true measures of "expert performance." As team members learned client expectations and experimented with software, they developed techniques and short-cuts conducive to quicker product iterations – in short, expertise. Solutions were derived quicker. Building upon each other's expertise developed a deeper pool of knowledge in order to launch further, develop faster, think deeper, and ultimately build better products due to learned dexterity and more solid concepts. At the end of the 2-week period, both expertise and expert performance increased exponentially within the group.

Finally, PBL is principally group-based. Every team member brought different schemata and professional experience, and debate and discussion were vital in discovering the best solutions for client needs. The team deliberated over every tactical decision from selection of images all the way to the final organization of NMR product presentation to the client. The team also met before and after hours in order to discuss crucial points, to sharpen the final iteration of deliverables; product implementation challenges facilitated this, as well as sought as many alternatives as possible for client satisfaction. Finally, they inspired each other via related and non-related media in order to explore as much as possible before delivering the final product suite.

RESTRUCTURING TEACHING, LEARNING, AND THE CLASSROOM SPACE

UDL naturally complemented the PBL-centered goals of the NMR course, specifically Edyburn's (2010) propositions for UDL directions (p. 36). Edyburn's first proposition notes that UDL in built environments is not the same as universal design in education, suggesting that in education, "much more attention must be devoted to the complex interactions between learning objectives, learner characteristics, performance support strategies, technology, and outcomes" (p. 36). This comparison of education with the "built" environment invites a similar comparison between the design of the PBL-centered classroom and the traditional classroom, and ultimately supports Edyburn's suggestion that the essence of UDL is design (p. 38). Indeed, the traditional classroom is a built environment in which the physical structure of the space enforces the pedagogical hierarchy, with power concentrated in the instructor and the syllabus, and the course itself constructed according to set principles and without any detailed knowledge of specific learner characteristics. In contrast, the PBL classroom distributes power to the learners, and in so doing creates a sort of self-structuring environment that inevitably takes into account learner characteristics, performance support strategies, technologies, and outcomes. This change is course focus leads naturally to a

change in learning and assessment, but it is also a change that must be accompanied by a physical transformation of the learning space.

First, UDL demands a restructuring of the power center of the classroom, eliminating the centrality of the instructor, who ceases to design and "run" the course and instead becomes more of a mentor and a resource, existing, in PBL, to "facilitate the group's work and internal communication" (de Graaff & Kolmos, 2003, p. 659). This is perhaps a more profound shift than the move to a focus on differentiated instruction envisioned by Edyburn (p. 38). Part of this move away from instructor-centered design is a comparable move away from syllabus-centered design—a move that is key to full implementation of PBL, and accords with de Graaff & Kolmos's "problem project" model (p. 660). Accordingly, the TTU New Media course was organized purposefully without a static syllabus; without a complete set list of readings; and with flexible timelines determined by project needs, by students' skills and knowledge and interactions, and by instructor guidance. In what seems from the traditional perspective an odd turn of events, the syllabus was ultimately a retrospective document provided after the completion of the course, created by all participants in class, as it logically should be, describing rather than controlling the learning and assessment. Indeed, the degree to which the NMR course diverged from other courses, even other graduate courses within the same program, seems sufficient proof of Edyburn's assertion that UDL does not occur naturally (p. 38), and is not simply good teaching, as noted above. The power of problem-based UDL structure is in its design, and the "good teaching" that it demands is so profoundly different from the traditional concept of instruction that it is likely never to occur "naturally" but only by deep reflection that makes many complexities seem simple and purposeful.

Additionally, as Edyburn notes, UDL must be measured by both primary and secondary effects. He argues that good design often assists a wide range of groups who continue to use it in a non-assistive way (p. 39). As such, it is reasonable to consider PBL, which is designed to be a fundamental change benefitting all learners, as one key to UDL. Indeed, Edyburn asserts that UDL is not assistive technology because it is "given to everyone with the understanding that those who need specialized support will use the tools when they need them (i.e. embedded, just-in-time supports)" (p. 39). However, this idea of specialized support is precisely the consequence of the distributed power structure of the PBL course, where all students are not only afforded the opportunity to seek the support systems of fellow team members and the instructor, but are placed in a situation that offers the innately motivating force to do so. In this sense we see that PBL is a means of increasing accessibility in the broadest terms and fulfilling the "universal" element of UDL.

The shift away from teacher-centered classrooms requires physical environments that can support and empower such teaching approaches; such a shift is ultimately enabled by technology, which naturally lends itself through a mélange of mediums in our Digital age. As Edyburn (2010) states, "to suggest that the potential of UDL can be achieved without

technology is simply another way to maintain the status quo" (p. 38). In NMR, the shift toward a decentralized classroom occurred in MuLL, a place that supports the teaching, research, and service of faculty and students (Crane & Beaudin, 2011; Lauren, 2011; Rice, 2011). The lab is designed to support various levels of technological competency, but also to serve as a thinking and collaboration environment. Gone from this environment was the traditional teacher podium and student desks arranged neatly in rows. Instead, the team sat around a table in the middle of the room to discuss the project in length, and often retreated to computers to develop more ideas to bring to the group. The course moved through the project's varied details, as if the project was the thesis and continued direction over theory and practice supported the claims. The team also had a number of technologies available to them, including desktop computers, digital still and video cameras, and high-end printers and scanners. Even more reflective of the decentralized learning space, students volunteered their own resources such as iPhones and props to be used in the development of the final deliverables, all for the overall benefit of the group. The space design is focused on working together to solve communication problems.

The MuLL represents an ideological shift in teaching and learning. Dobrin (2011) explains how "space is the site of ideological struggle; place the result of that struggle" (p. 42). The ideological struggle that PBL embodies in classroom environments is empowering students to guide their own learning in authentic ways. After all, there are many voices in the classroom. Gutierez, Rymes, and Larsen (1995) explain these voices are often scripted by teachers and then counter-scripted by disenfranchised students. Further, the authors reason "nevertheless, in the face of a rigidly monologic teacher script, the relevance of students' counterscript to the processes or topics discussed in this classroom has little influence on the teacher's script. The only space where a true interaction or communication between teacher and student can occur in this classroom is the middle ground, or 'third space,' in which a Bahktinian social heteroglossia is possible" (p. 447). In essence, in third space social lines are redrawn to provide an authentic exchange of ideas and decentralize those who create and distribute knowledge—especially culturally informed or localized knowledge. A media lab space, such as the MuLL, can act as a sort of third space in lieu of traditional teacher-centered learning environments for productive problem-based learning teaching models.

Grego and Thompson (2008) recently adapted the term *third space* in *Teaching/Writing in Thirdspaces: The Studio Approach.* Grego's and Thompson's ideas are largely based on Soja's (1996) and Lefebvre's (1992) exploration of the production of urban spaces. Soja argues that there is a first space (what we concretely conceive in the material world) and second space (what we can imagine in a theoretical world). Third space, on the other hand, "can be described as a creative recombination and extension, one that builds on a first space perspective that is focused on the 'real' material world and a second space perspective that interprets this reality through 'imagined' representations of spatiality" (Soja, 1996, pg. 6).

Grego and Thompson adapt third space to represent a space outside of the classroom, where small groups of students meet to focus only on their writing.

The "third space" was further developed by the use of a closed Facebook group in which ideas could be stored, sorted, prioritized, and commented upon. This digital workspace was a fluid space where products could be viewed throughout iterations, where memorable music videos could be posted, and where inspiring catch phrases could be considered and enjoyed. Team members relied on this space for updates as well as immediately critical communication and information sharing, but the space this project created explored what Clark and Young (2005) discuss when they talk about service-learning as "work that goes beyond the transformation of individual students through service experiences" (p. 85). Facebook, as well as the media lab space in which the team worked, became a purposeful think-tank, as previous student teams and the instructor have reflected on in more detail (Crane & Beaudin, 2011; Lauren, 2011; Rice, 2011). Accordingly, tensions emerge and help us better understand that courses which reproduce "thick places" and complex rhetorical workplace situations authentically enable students to inhabit community spaces in their learning (Clark & Young, 2005).

Also, UDL can provide impetus for project completion strategy. For instance, the Facebook group offered tremendous insight into thought processes of team members, and assisted in developing working plans and a timeline of deliverables for artifacts produced. Music video clips, intercultural connections, as well as iterations of deliverables almost created a mosaic effect on the Facebook page so that each member could hunt for his or her own needs, be it inspiration or an in-depth review of product statuses. Manovich (2001, p. 60-61) mentions "What before had been a mental process now became part of the public sphere. Unobservable and interior processes and representations were taken out of individual heads and placed outside. What was private became public." This reflects the brilliance about new media technology. Manovich (p. xxv) also mentions that "new media objects contain a hierarchy of levels" such as interface (content), operating system (application), assembly and machine language. These components needn't lose their individual identities as various parts to the product suite puzzle are addressed; however, they do need to be seamless and liquid, complementing and playing upon each other. "Individual layers can retain their separate identities rather than being merged into a single space; different worlds can clash semantically rather than form a single universe" (p. xix). A quick update on the Facebook page would assure team members' progress for component artifact production. Furthermore, different team members worked with the instructor to develop different specialties in order to streamline work.

UDL networks can elucidate the metacognitive "why" of learning. Ultimately, the situation was a real-world situation in which members could make connections and observe in real-time why they were doing what they were doing. In spite of occasional team conflicts, goals

were clear and each member took up slack in order to meet deadlines and contribute effectively. The image below features the team's Facebook page, a team members-only environment in order to share ideas and encourage progress. Examples of dialogue include culturally-telling Facebook profile images; client audio for embedded video; subtitling program for video accessibility; inspiring digital humanities projects; iterations of logos; and final products. All team work was accessible by simply logging into Facebook accounts.

Figure 2: NMR Team Facebook Page

When a class focuses its reading, writing, thinking, and deliverables on an authentic client's needs, its audience becomes mixed and complex and the content it produces useful and real rhetorical situations. This rhetorical situation calls for NMR students to use the "power of persuading" (Quintilian, p. 385, 2001).

CONCLUSION

In the case of the NMR students, the merging of PBL and UDL within the context of the media lab was a success. A high-quality suite of deliverables was provided to TxMSC on time and in a professional manner, yet the journey took more center stage. NMR students learned how to learn from each other, how to develop key skills, and how to negotiate the production of deliverables via a radically restructured PBL course in a media lab. It wasn't an easy process, yet employing new thought processes seldom is. It is our hope that our experience

can lead to continued improvement in the implementation of UDL principles in different courses.

While there is much evidence suggesting that PBL and UDL are productive techniques for teachers and students alike to meet educational goals, in many ways using these approaches can conflict with traditional pedagogical methods. The operative word is "traditional." We needn't shy away from risk-taking in terms of Digital age classroom practices, and in order to reach student populations and expansive audience bases, it is vital to explore new options, new alternatives. A UDL inspired PBL course in a media lab is one solution for the university to maintain relevance in an ever-changing contemporary world. Indeed, as was depicted in the case of TTU's NMR students, using this approach can render the lecture, the syllabus, and, even the typical classroom space as mutable, maybe even unnecessary, components of the course. Not surprisingly, this can cause apprehension on the part of both the instructor and the student.

Then again, this could provide an organic solution to the modern day classroom. It is already accepted that classroom pedagogy is in dire need of an overhaul to reflect the Digital age, as we have well outgrown classroom dynamics of previous decades. It's time: The combination of new media technology within PBL, UDL, and Manovich's principles can facilitate real-world dynamics as well as real-world solutions. Team members learn theory, build upon that theory, and apply their new knowledge for future working situations after they leave the classroom and join the workforce. Given the possibility of a mutually rewarding outcome, it is important that instructors consider the benefits of using a hybrid model; employing UDL within a framework of PBL can offer more dynamic solutions to embrace the changes that doing so engenders.

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