Competence and Problem Based Learning

Experience, Learning and Future

Esa Poikela & Sari Poikela (eds.)

Rovaniemi University of Applied Sciences
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Contents

Challenges of problem-based pedagogy

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The principles of Problem-Based Learning change the culture of learning in many ways. PBL changes the relationship between a learner and a teacher, the collegial relations between teachers and it has impacts at the organisational level. In the broadest sense, all the functions of an organization have to be re-evaluated and re-organised according to the principles of problem-based pedagogy. Curriculum development becomes a collaborative process continuously evolving and integrating every single teacher in the process. Ideals and practices have to correspond with one another at the level of action. If these meanings at the meta- and macro levels of an organization are disregarded, PBL is easily misunderstood as a static construction of a doctrine rather than as a transforming educational strategy.

The first aim of our article is to give the theoretical perspective for problem-based pedagogy. Secondly, we describe those inevitable changes in organizational, curricular and personal levels that are needed to for successfully bridging learning and work. Finally, we shortly present the content of this collection of the articles connected to the conference 'Competence and Problem-based learning – Experience, Learning and Future'.

Epistemological background of problem-based learning

In epistemological discussion the relationship between knowledge and knowing can be understood as a debate between Cartesian finite and Heideggerian changing knowledge. The former represents the modern idea of permanent knowledge, and the latter the post-modern way of apprehending knowledge as changing and dependent

on the context of the activity, rather than on facts or truth. Problem-based pedagogy can be characterised as a paradigm shift towards a post-modern society and a new epistemology (Cowdroy 1994).

Few scholars have attempted to distinguish between the epistemological and ontological dimensions of knowledge. Nonaka & Takeuchi (1995) do make this distinction. They argue that the epistemological dimension describes conversion processes from implicit (tacit) to explicit knowledge, and vice versa, from explicit to implicit knowledge. The result of this conversion is new knowledge and a new way of knowing and acting. The ontological dimension, on the other hand, describes knowing processes that take place between an individual, a group and an organisation. Cook & Brown (1999) also make the same kind of distinction between the mode of knowledge and the possession of knowledge. In their view, knowledge can be explicit or implicit and is possessed by an individual or a group.

According to Nonaka (1994) explicit knowledge is symbolic, observable knowledge and implicit knowledge refers to nonverbal, tacit knowledge which is hardly observable. The ontological dimension concerns knowledge existing somewhere and owned by someone: knowledge can be individual or collective. Tacit knowledge is subjective in nature and it is bound to personal, collective or organisational competence. This means that producing and delivering tacit knowledge depends on individual and collective action.

Nonaka and Takeuchi (1995) examine subjective tacit knowledge, while Ståhle and Grönroos (1999) study objective potential knowledge in the sense that it has not yet been transformed into the form of individual or common competence. Potential knowledge is a possibility embedded in environment and it is an object of goal-oriented thinking and action (c.f. Barab & Roth 2006). We are used to calling this kind of thinking and acting learning when practised within the framework of the curriculum in formal education and in the form of professional development and informal learning in working life (Poikela, S. 2005).

Instead of the traditional two-dimensional theory/practice description, a holographic three dimensional view of knowledge consisting of *theory, praxis and experience* and *experience, practice and competence* should be adopted (see Figure 1). As the most important elements of producing competence, the concepts of objective and subjective, potential and tacit knowledge challenge former dichotomies of knowledge. It is no longer possible to divide knowledge simply into the theoretical "that" and the practical "how". A more useful division is theoretical "that", practical "that" and experiential "how" knowledge. This locates knowledge in a new way and the dichotomy between theoretical and practical knowledge takes on the shape of a triangle where the third dimension is experiential knowledge. This makes it possible to clarify what part of knowledge is

objective, existing outside of an individual (theory and praxis), and what part is subjective, experiential (experience, practice and competence) knowledge.

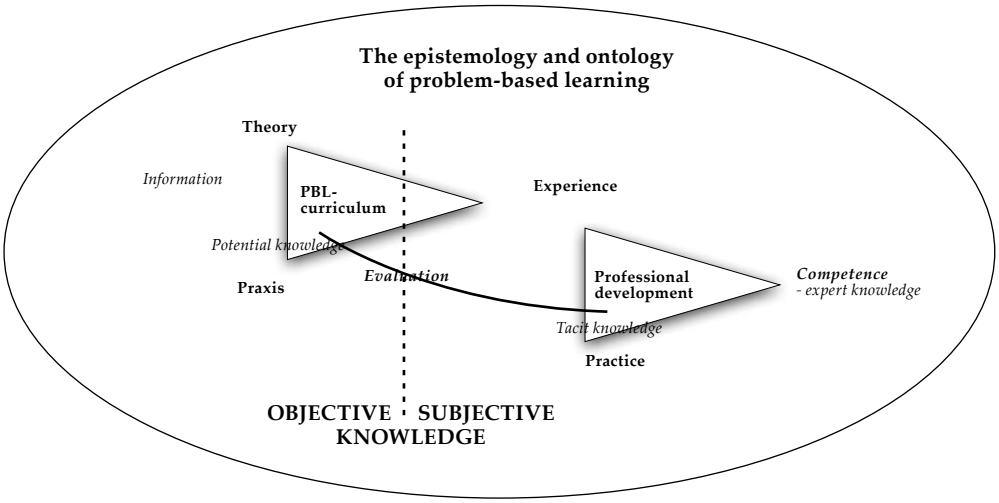

Figure 1. The contextual framework of the problem-based curriculum (Poikela, E. & Poikela, S. 2005)

Conceptual knowledge in textual, codified or any other symbolic form is not the same as it is in the memory of an individual, a group or an organisation. Correspondingly, practical knowledge is not only in the possession of a professional, but can be embedded in artefacts produced by humans or in objects of nature. From the point of view of the learner, theoretical and practical knowledge, like any information, are sources of potential knowledge, the goal of learning lying outside her or himself. The integrative knowledge from and between theory and praxis/practice is needed for constructing experience, the mode of subjective experiential knowledge, including the highly personal elements of tacit knowledge.

Figure 1 clarifies the basic idea of learning. The left-hand triangle depicts the world of education, and the right-hand triangle the world of work and professions. The aim of teaching is to guide the learner to deal with substance so that it is possible to integrate necessary theoretical knowledge (from theory) and practical knowledge (from praxis/practice) in the processes of learning. The result of the integration is experiential knowledge (forming experience) which has a permanence not enjoyed by knowledge gained from the memorisation of facts without connection to practice, or from emotional experiences without theoretical understanding. Figure 1 also depicts the *contextual, chronological* and *ontological* transition between education and work life. Practitioners continuously learn at work (within a community of practice) and deepen professional competence (in personal practice) during the whole of their work history.

The spaces for learning

Pragmatic philosophers of education (e.g. Dewey 1933; Freire 1972) emphasise the importance of learners' actions and facilitating these in the processes of growing and development. The way learners' experience is constructed is crucial, and also how they learn "to read" the concrete, social and cultural environment in which they act in the contexts of everyday life, work and education. Our information society offers a huge amount of data, but it does not offer knowledge when examined from the perspective of learning. The curriculum is full of theories, models, facts and exercises but, from the learner's perspective, this is just information coded and packed in a formal mode. Information is transformed into knowledge only when personal meaning is attached to it in the process of learning.

The dilemma of creating meaning is usually expressed in pedagogical discussion as difficulties in personal motivation, commitment and the ability to receive information. Praxis, arising from real problems is more useful for learning than theory because only in this way is it possible to create sense and structure ways in which to use theories. Learning is carried out through actions that can be aimed at achieving certain goals and targets in reality-based problem-solving processes. This is why education cannot be based on the transmission of information and skills coded as written text in books. A solid basis for education lies in functional models and in developing abilities leading to lifelong learning in our present and future society.

For the student, the curriculum is primarily an environment of information, knowledge and learning. For the teachers, the curriculum is an active process which helps to define the teacher's work. The process has its participants (students), its subjects (teachers) and its owners (educational units and institutes). Both the teacher's and the student's viewpoints must be simultaneously taken into account in planning. There is no shortcut to the space for learning, though. Its creation requires both research and development.

For the study of learning and the development of environments and spaces, a hypothetical model (see Figure 2) can be presented which aims to combine the learning environment idea of the ecological curriculum and the trialectics of pedagogical production of space. Figure 2 depicts the zones of learning, which are physical (e.g. workshop, classroom), social (e.g. type of group, communication relationships), and cultural (e.g. "the rules of the house", professional culture) learning environments. The environments define the context and help to define the goals of learning at any given moment, as well as what the conditions for realizing these goals are.

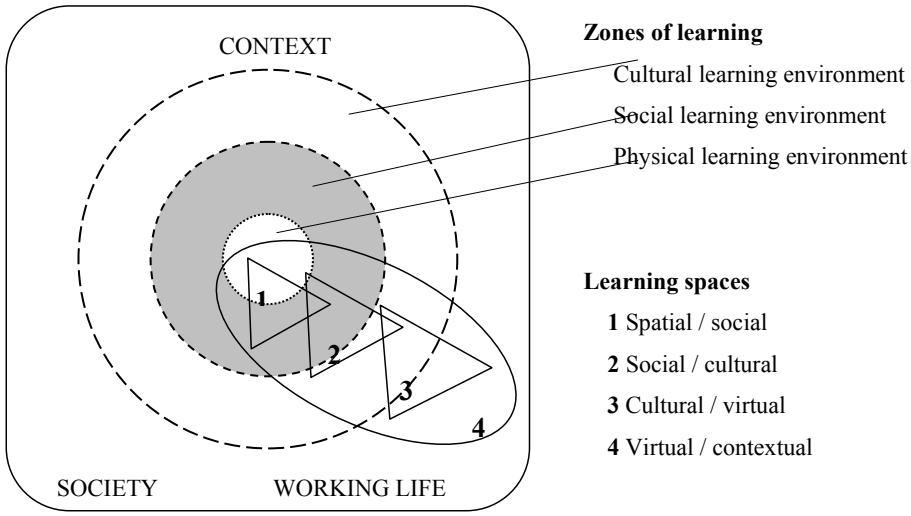

Figure 2. The zones and spaces for learning (Poikela, E. 2010; 2012b)

In the physical environment, the primary goal of learning can be the adaptation of spatial practices and the study of mental models, and at the same time also the development of social skills. The primacy of the social environment brings social skills into the focal point, and it is also connected to the creation of mental models, with the material practice acting as an influencing factor in the background. At the centre point of the cultural learning environment are principles, facts and beliefs connected to practices, artefacts, values and ethical bases. Thus the zones of learning, depicting different environments, provide the background and define the space where learning becomes possible. Since the environments are open, a more limited concept of the space for learning is also needed for the purposes of research and development, to better match the requirements of planning.

The spaces for learning have been defined as existing on the surface areas where the zones of learning meet. In the spatial-social space for learning (1), crucial factors are the functional and social relationships to the subject matter, to the tools and the co-actors, which shape the learners′ experience. This brings up questions regarding the architecture of space, functionality, and use of sensory information that spatial and social learning related to work and professionalism might require.

In the social-cultural space for learning (2), the most crucial factor is learning to handle different models of action and thought, to work with different people and to solve also ethically challenging problems. The main question is, what kind of thinking, logic, co-operative and problem solving skills are expected of a professional in the changing situations of their future working-life.

The cultural-virtual space for learning (3) opens a connection to a limitless world of information and knowledge, teaching the students to work in a network independent of time and space, and to study things with people they have never met. The questions that come up concern the kind of skills that professionals in the field and global actors will be increasingly needing, including information handling and media skills, skills in using, creating and evaluating information, and skills in ethical practice.

The virtual-contextual space for learning (4), as educational technology and as a tool for creating simulations, has been designed for the purposes of developing acquisition and creation of knowledge, maintaining interaction, reflective problem solving and critical assessment. Compared to the other spaces for learning, it differs from them in that the spatial, social and cultural factors of space must be re-structured and re-created in it. The most fundamental question is, what kinds of new spatial, social and cultural practices the net and the networks will produce, and how they can be used to create realistic learning environments, and to support the learning that happens in real environments.

Guiding Learning in Space and Time

The utilization of space as a supporting and directing learning resource is a very experiential thing from the perspective of the learner. Learning that takes place in a space can be observed using the experiential and reflective learning theory. Reflection is the core of learning and the key to directing the learner and understanding evaluation. Kolb (1984) states that reflection is the observation and analysis of experiences by the learner alone and together with other learners and with the instructor.

Kolb has been accused of considering reflection only partially, and only as one stage in the cycle. Schön (1983) also connects reflection to action, on the basis that action always includes breaks and situations that offer opportunities to think. Reflection is thus possible both in the course of action (reflection **in** action) and after the action has happened (reflection **on** action). According to Boud et al. (1985) and McAlpine et al. (1999), reflection can also happen in the stage of conceptualization, where it means careful mental preparation for action (reflection **for** action). Therefore, the image of experiential learning can be further clarified (Figure 3) by adding reflection to its stages that produce learning.

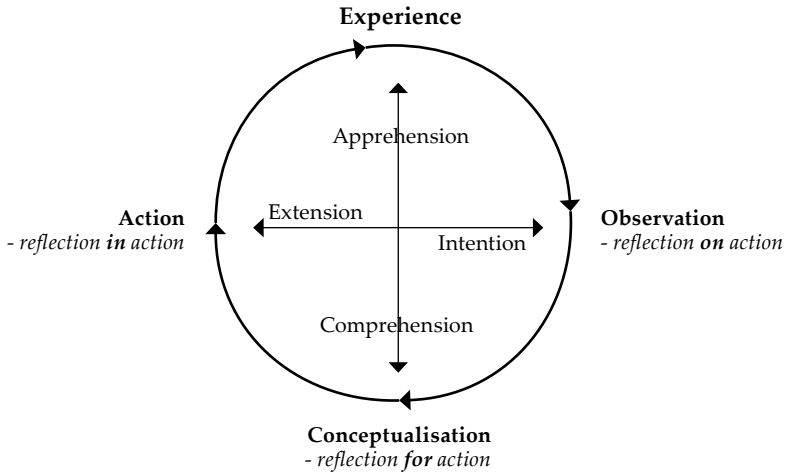

Figure 3. Experiential and reflective learning (Poikela, E. 2010)

The concrete experience is both the starting point and the result of learning, which is the consequence of the cyclical process occurring in time and place. The relationship between the reflective observation and the external actions of the learner, i.e. the active experimenting with the learned content, is tensioned. The purpose of the tension is to maintain learning by doing and thinking. Reflection is followed by conceptualisation, which may be performed by combining earlier knowledge with new knowledge. The relationship between conceptualisation and preceeding and future experiences is dialectical, which increases the motivation for and the commitment to learning. New experiences are the result of action and experimenting and they enrich, deepen or renew preceding experiences and create the new starting point for the deepening progress of the cycle.

The most comprehensive definition of reflection, reflecting and reflectiveness have been offered by Mezirow (1981; 1991). According to him, reflectiveness is a prerequisite for learning. Reflection starts with the perception and recognition of affects, emotions and sensations, extending through concept formation all the way to theoretical reflectiveness. Reflection is aimed at the content to be studied, as well as action processes and knowledge constructions, values and beliefs affecting action. Through critical reflection, learning can reach a *transformative* level, where it changes the individual's schemes and perspectives of meaning. Meanings and structures of meaning in turn direct the acquisition of knowledge, learning, development and action in different stages of the individual's life.

When learning is perceived as a process permeated by reflection, with the aim of producing experience and expertise, guidance is also required to be transparent and to support reflection in the students. For example Lähteenmäki (2004) presents a model

of *reflective guidance* for learning at work, which is built on analysis of reflection, supported by the instructor, in the stages of experiential learning (reflection *on, for & in* action). At the "*on*-stage" of learning, reflection requires the instructor to have the ability to activate the students' thoughts connected to their experiences, and to be aware of the effect of the guidance and feedback on the student, also at the emotional level. At the "*for*-stage", one of the most crucial tasks of the instructor is activating the students to approach new sources of knowledge, and to plan the action. At the "*in*-stage", the most important components of reflective guidance are arranging the learning situations, giving advice, and building a positive atmosphere for learning.

Reflection can be seen as the smallest common denominator for the learning and assessment processes. In learning, reflection opens possibilities for both processing knowledge and for guiding learning as action. In assessment, reflection is the basis for self-assessment and joint assessment, and it extends to the conscious setting of goals and critical evaluation of results. The core of guidance is to develop the students' *ability to reflect*, which includes reflection on one's own actions, giving and receiving peer feedback, feedback discussions with instructors, and setting goals in terms of outcomes. On the other hand, quality criteria and numerical measures are needed in order to ensure the quality level of expertise. Students need to be continuously informed about the results of their learning and the level of their skills. For this we need clear indicators, connected to standards of competence, which are used to provide proof of expertise in the degree certificate for the purposes of working life.

The Process of Problem-Based Curriculum

Employing action pedagogy means making students into participants, co-operation between teachers in planning, and providing institutions of learning with the resources to create and continuously maintain spaces for learning. For example, by combining the advantages of problem-based pedagogy, which produces understanding, and those of project learning anchored in practice, the result can at best be a reflective and research-oriented learning process, which can be realized in learning spaces created in a varied and multidimensional manner, which will in turn produce the best professionals and experts.

Problem based pedagogy represents functional strategy and working life oriented practice, which is structured around working life based problems and learning that takes place in tutorials[1] (see Figure 4). The problems are not any situations or difficulties related to working life or professional work. They must be carefully selected,

[1] Tutorials, which are the dynamo of PBL, happen in groups of 8-10 students that meet about once a week, guided by a tutor.

planned and devised to form the basis of meaningful learning. It is not enough for the training to answer the needs of today's working life, because in the future the students will also have to manage the professional challenges of their working life future, they must be able to adapt their competence as their tasks change, and they must even be able to change their profession. This means that being working life based is not just about competencies needed immediately at the job, but also about the future demands of the work and the profession (Poikela, E. 2006; 2007).

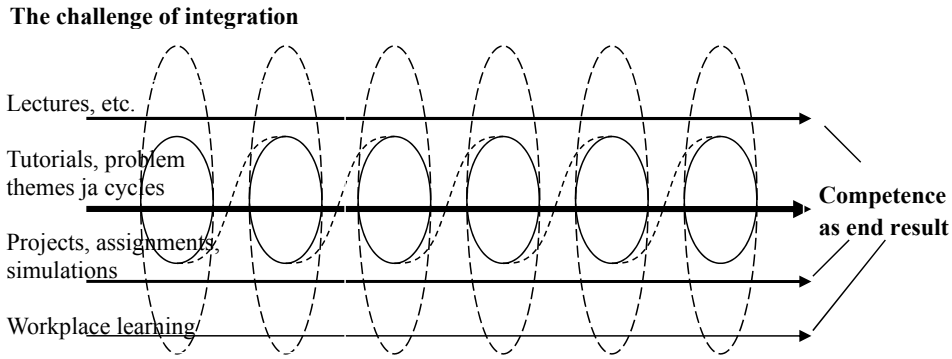

Figure 4. The problem based curriculum process (Poikela, E. 2012a; 2012b)

The problem-based curriculum is organized around problems and problem themes that produce core competence (for example academic or general professional abilities). This means taking into account time, place and situational factors as problem solving proceeds. Lectures, assignments and other working methods are still produced outside the tutorials, but their timing is renewed, and their content is shaped to serve the needs of problem solving. Adopting PBL usually leads to a reduction in face-to-face teaching, because students are guided to obtain for themselves most of the information that was previously handed out at lectures (Poikela, S. 2003; Poikela, E. & Poikela, S. 2005; Poikela, E. 2012a; 2012b).

The problem-based curriculum offers students an information, knowledge and learning environment where they participate, act and think actively in order to produce their own competence. The task of the curriculum is not just to provide an action environment for the students, but to provide a physical, social and virtual space where all factors that can further learning have been predicted, defined and planned as well as possible (see Poikela, E. 2010). For teachers, the curriculum is a process that gives direction to the guidance and assessment of learning, and to management and development as well. It requires continuous cooperation with other active parties. From the culture of learning alone and teaching alone, we are moving towards collaborative ways of working and thinking.

A new solution is needed for the appropriate scheduling and content-related allocation of theses, projects, simulation and learning in working life in the PBL curriculum. The virtual learning platforms that have been utilized in web-based studies provide new possibilities for reaching the solution (e.g. Kärnä 2011). The function of the curriculum is not merely to provide the operational setting for learners but the physical, social and virtual space in which all the factors that facilitate learning have been anticipated, defined and planned as well as possible.

The tutorial cycle of problem-based learning is the basic state of *epistemic work*. Through this work it is possible to learn the thinking skills that form the basis for expertise and professionalism, but for entrepreneurship, as well. This is not only a matter of skill or even attitude, but identity, which is a personal basis for a personal relationship towards work and profession, and for the ability to develop one's own competence as working life changes.

The content of the book

The collection of the articles reflects well the different disciplines and areas of teaching in higher education where PBL is implemented. Following this introducing chapter of the book the second article deals with Public Health education program at the University of Bedfordshire, United Kingdom. The program is delivered both face-to-face and in an online environment. It gives a good example how ethical issues need to be considered carefully as part of learning and teaching.

The third article also gives an interesting view to the use of ICT in PBL in Zurich University of Teacher Education, Switzerland. It states that former writings on ICT in PBL have had too strong focus on technology, rather than consideration about the design and features of ICT from point of view of instructional psychology. The article gives also practical examples how ICT can support both the teachers and learners work.

The forth article is written by the teachers and researchers of Rovaniemi University of Applied Sciences, Finland. It reports the experiences from Human Resource Management program in master level and captures the key success factors for the implementation of PBL within adult education. It also highlights the need for a more extensive use of participatory and student empowering pedagogies in management education.

The fifth article assesses the outcomes of PBL in Economics at the University of Waterloo, Canada. The assessment practices of traditional lecture based courses may communicate to students that the discipline has single right answers which is not the case in complexity of working life. PBL is designed to provoke and develop curios-

ity, self-directed learning, engagement and critical thinking. These are the abilities students need in their professional future.

The collaboration between university students and working life when learning and teaching environmental technology is the object of the sixth article written by the teachers and researchers of Aalto University, Finland and Lahti University of Applied Sciences, Finland. It presents the learning experiences of course where PBL is used as a workshop tool to improve subject specific skills and communication.

The seventh article emphasizes the promotion of participatory learning in higher education. The authors are teachers in Social Services degree program at Arcada University of Applied Sciences, Finland and all of them have a long history of acting as tutors. They give both theoretical and practical perspectives to tutorial work and use the interesting metaphor of "deep diving" process in tutorials.

Researchers at Lodz University, Poland have started to develop the teaching of Mathematics utilizing the ideas of PBL. This is reported in the eighth article. The development is at the early stages but even so the results are encouraging. Students are focusing more actively on information acquisition and developing the skills of cooperating together. Teachers are almost surprised about students' higher performance, enthusiasm and better understanding of mathematical formulas. However challenges exist. Fair forms of grading criteria needs to be developed and preparation of problem scenarios has proved to be challenging.

The ninth article also deals with early stages of PBL. Researchers of the University of Coimbra, Portugal have examined the Portuguese writings about PBL. Their aim is to present a summary of the main research found in internet and Portuguese data basis. The major of writings concentrate on students experience on PBL. The further aim of the authors is to develop the teacher training on the basis of PBL principles.

The last article of the book is written by researchers from Lithuania. They state that one of the important roles of higher education is to prepare students for lifelong learning. They have realized the benefits of problem-based pedagogy and are starting to develop a more integrated curriculum based on PBL at Business Management Faculty at Kauno Kolegija University in Applied Sciences. The main question of the article is how to develop the competencies of the employees at the tourism enterprises.

References

Barab, S. A. & Roth, W-M. (2006) Curriculum-based ecocystems: Supporting knowing from an ecological perspective. Educational Researcher 35, 5: 3-13.

Boud, D. (1985) Problem-based learning in perspective. In D. Boud (ed.) Problem-based learning in education for the professions. Sydney: HERDSA. 13-19.

Cook, S. D. & Brown, S. J. (1999) Bridging epistemologies: the generative dance between organizational knowledge and organizational knowing. Organization Science 10, 4: 381-400.

Cowdroy, R.M. (1994) Concepts, constructs and insights: the essence of problem-based learning. In S.E. Chen, R.M. Cowdroy, A.J. Kingsland & M.J. Ostwald (eds.) Reflections on problem-based learning. Sydney: Australian PBL Network.

Dewey J. (1933). How we think: A restatement of the relation of reflective thinking to the educative process. Boston: D.C. Heath and Company.

Freire, P. (1972) Pedagogy of the oppressed. Harmondsworth: Penguin Books.

Kolb, D. (1984) Experiential Learning. Experience as the source of learning and development. New Jersey: Prentice Hall.

Kärnä, M. (2011) Virtuaalinen tiedonrakennukset tila ongelmaperustaisen oppimisen tukena. Acta Universitatis Lappoensis 80. Lapland University Press: Rovaniemi.

Lähteenmäki., M-L. (2004) Reflectivity in supervised practice: conventional and transformative approaches to physiotherapy. Learning in Health and Social Care, 4, 1: 18–28.

McAlpine, L., Weston, C., Beuchamp, J., Wiseman, C. & Beuchamp, C. (1999) 'Building a metacognitive model of reflection', Higher Education, 37: 105-131.

Mezirow, J. (1981) Critical theory of adult learning and education, Adult Education, 32: 3-24.

Mezirow, J. (1991) Transformative dimensions of adult learning, San Francisco: Jossey-Bass.

Nonaka, I. (1994) A dynamic theory of organizational knowledge creation. Organization Science, 1, 5: 14-37.

Nonaka, I. & Takeuchi, H. (1995) The knowledge-creating company. New York: Oxford University Press.

Poikela, E. (2006) Knowledge, Knowing and Problem-Based Learning – some epistemological and ontological remarks. In E. Poikela & A.R. Nummenmaa (Eds.) Understanding Problem-Based Learning. Tampere: Tampere University Press. 15-31.

Poikela, E. (2010) The design of learning. In S. Ruohonen & L. Mäkelä-Marttinen (eds.) Towards a Learning and Competence Creating Ecosystem - LCCE. Publication of Kymenlaakso University of Applied Sciences, series A, no. 28, Jyväskylä: Kopijyvä Oy. 10-17.

Poikela, E. (2012a) Learning, Work and Competence - Facing the challenges of expertise and entrepreneurship. In R. Pelli & S. Ruohonen (eds.) Learning and Competence Creating Ecosystem - LCCE. Publication of Kymenlaakso University of Applied Sciences. Serie A. No 32. Tampere: Tammerprint Oy. 24-33.

Poikela, E. (2012b) Knowledge, Learning and Competence – The Boundary Conditions of Simulation Pedagogy. In E. Poikela & P. Poikela (eds.) Towards Simulation Pedagogy. Developing Nursing Simulation in a European Network. Publication of Rovaniemi University of Applied Sciences. Serie A. No 2. Rovaniemi: Erweko Oy. 18-29.

Poikela, E. & Poikela, S. (2005) ProBell: A Finnish Problem-Based Learning (PBL) Research Network. In Barrett, T., MacLabhraim, I., Fallon, H. (eds.) Handbook of Enquiry and Problem-Based Learning. Irish Case Studies and International Perspectives. AISHE, All Ireland Society of Higher Education & National University of Ireland, Galway. 217-225. http://www.nuigalway.ie/celt/pblbook/chapter21.pdf

Poikela, E. & Poikela. S. (2005) The Strategic Points of Problem-Based Learning – organizing the curricula and assessment. In E. Poikela & S. Poikela (eds.) PBL in context. Bridging Work and Education. Tampere: Tampere University Press. 7-22.

Poikela. S. (2005) Learning at Work as a Tutor – the processess of producing, creating and sharing knowledge in a work community. In E. Poikela & S. Poikela (eds.) PBL in context. Bridging Work and Education. Tampere: Tampere University Press. 177-194.

Schön, D. A. (1983) The Reflective Practitioner: How Professionals Think in Action, New York: Basic Books.

Ståhle, P. & Grönroos, M. (1999) Knowledge Management – tietopääoma yrityksen kilpailutekijänä, Ekonomia-sarja, Helsinki: WSOY.

Ethical issues in problem-based learning

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This paper addresses the use of problem-based learning as part of a Masters programme in Public Health for mixed groups of working professionals around the world. The programme is delivered both face-to-face and in an online environment for learners overseas, and as part of both programmes, the learners must engage with a case study involving ethics and legality. Learners choose a true life case study from their own area of practice and present it as a seminar for the other learners. Then everybody else participates in a discussion about the ethical and legal aspects of this situation. The next part of the process is for each learner to decide on a policy that would mean that a similar situation could be avoided in the future. The paper also addresses the issue of emotions and anxiety caused by some of the topics covered by problem-based learning, and how a teacher must be prepared to console or support the learners who become upset. We examine, in conclusion, some of the ethical issues involved in *teaching* ethical issues in Public Health – questions of privacy, anonymity, codes of conduct, processes, rules and principles.

Introduction

The Masters programme in Public Health is delivered in two ways: face-to-face and in an online environment, the latter being principally for the benefit of learners over-

seas. Irrespective of the various challenges inherent in the different modes of delivery (Sapsed and Mathew 2011), the two modes share certain tasks that are presented to the learners. One of these tasks involves the learners engaging with a case study involving ethics and legality, in which learners choose a true life case study from their own area of practice and then present it as a seminar for the other learners; the objective is to develop empowering pedagogies so that each learner can act as a change agent in his or her own life and education. Then, following the presentation, everybody else participates in a discussion about the ethical and legal aspects of this situation. The final part of the process is for each learner to decide on a policy that would mean that a similar situation could be avoided in the future.

The Public Health programme, therefore, is an example of problem-based learning that is attached to a consideration of ethical issues. Problem-based learning might be defined as the use of a real world situation as a context for learning (Michel *et al.* 2002). It endeavours to build conceptual network of knowledge in our learners, which can then be transferred to a range of practical settings (Cruickshank and Olander 2002). In many cases, the true-life problems that are used as part of the Public Health Masters may not have a strictly right or strictly wrong answer: the encouragement and development of critical thinking skills, via teamwork and discussion, is one of problem-based learning's primary goals, which is used to good effect on this programme. In addition to this, the approach is a way of working with learners in order to augment their ability to solve problems, and to work efficiently as part of a team. Furthermore, following Albanese and Mitchell (1993) and Ryan and Quinn (1994), closely aligned with these aims are the learning outcomes of self-directed learning, self-evaluation, and the ability to contain anxiety and to adapt to change in the working environment. It is fruitful ground, with the emphasis very much on the process and not the product (Shannon and Brine 1994).

Needless to say, however, the issue of ethics is rarely absent from any discussion of public health matters, and it is rarely far from problem-based learning either. If the subject under consideration is either based on a real life incident, or is actual reportage of an incident (for example, a medical matter that has made it into the national news), then there must be thought given to the ethics of (first) teaching around it, and (second) encouraging the learners to draw conclusions from what might not be a closed case or what might have been incorrectly reported in the first place. If the matter is contentious, there is likely to be emotion attached – anger or dismay, for example, in a case of medical negligence or neglect – and it is our job, as educators, not to allow a 'lynch-mob' mentality to thrive, or even to take root: our learners are not the judges in a case of malpractice (for example); the aim is for us (and them) to strengthen pedagogic strategies. Indeed, the problem-based learning environment exists to empower learners to analyse a problem in its own and the learner's context (Coles 1991). For this to succeed, and for the learner to construct a method of arriving at a detailed analysis, the educator must be cautious not to impose his or her system

of idiosyncratic ethics, or even beliefs. Learners must not be forced to follow one pre-trodden path to a conclusion that the *educator* has already drawn.

Let us look at a few examples that have been used on the programme so far. In the following section of this paper, the names but not the places have been changed. This consideration of anonymity has not been imposed on us (for reasons that will become clear), but is – in and of itself – the result of a consideration of ethical issues. Although there is little chance of anyone recognising the precise person on whom these case studies are based (the examples, alas, are all too frequent), we have decided to protect the identity of those who have suffered or have been served short shrift in one way or another.

Example 1: India

Ahmad, a 35 year-old, low income labourer, living with three children in a poor house in the countryside in India, sold his kidney for few thousand Rupees. A few months later, he died in the local hospital after being admitted for post-transplant surgical complications, such as deep systematic infection and concealed bleeding. He was not properly informed of the surgery's risks, and suffered complications before and after the removal of his organ. Owing to an absence of good post-operative care, he failed to combat the fatal infection that took his life… In this one paragraph we might tease out a host of ethical complications. The selling of one's organs is undoubtedly one of these; but we must also take a look at some of the surrounding information in this particular case.

Ahmad had lived in a poor neighbourhood, where he was persuaded by one of his neighbours to sell the kidney. He sold it in order that his family might eat: it was not an ethical question that he posed to himself – it was a matter of urgency. All he wanted to make some short money, the better to support his family. We might easily argue (but perhaps should not) that it was not Ahmad's ethics that were in doubt: it was the attitude of the illegal agent who negotiated a price for the organ that must come under some scrutiny. Selling organs is big business; the agent had been found on a website, and had also been involved in an illegal international transplant tourism industry, in which his job was to find donors for recipients who were mostly from Western and Middle Eastern countries. In addition to the agent, however, a few professional doctors and members of hospital staff were found to be involved in the case. Ahmad's family have been left alone, with no any other resource to feed and live. For those who were involved (we might argue, in any capacity) in the removal of his kidney, it was their profession to vandalise people's lives without paying enough compensation to the donor and their family. They were exploiting the issues of legal and ethical principles in their professional practice. But by teaching this, what exactly

were *we* doing? If the aim was to bring to the learners' attention the immorality of *some* forms of organ trading, the case study has been successful: it has always engendered lively debate (and no small amount of moral disgust from certain learners); and if it is difficult to say what is 'right' and 'wrong' in this example, the issues of intercontinental *differences* in ethics, and the price put on a working man's life, are frequently crossly debated.

As we mentioned above, Ahmad's example has been anonymised, but there is little point pretending that the country is not India. Anonymity of the country itself would add nothing, and in fact might do a lot to make the study confusing. Although no one would claim (or believe) that payment for organs does not occur in the West or in more financially prosperous countries than India, the original situation of poverty is important.

Example 2: Pakistan

On November 29, 2009 at 3 a.m. in the morning, a three year-old girl named Imanae spilt hot water on her wrist. Although this caused only a very small burn, the parents chose to go to the hospital as the child was in a lot of pain. At the hospital they were met by the emergency ward staff, who applied an ointment on her hand and gave her an injection to soothe the pain. When Imanae continued to cry because of the pain, the nurse called the doctor on duty. When the doctor walked into the room he had a drowsy and drunken gate. The doctor instructed the nurse to give Imanae another injection. Imanae, however, continued to cry. Fifteen minutes later, the sleepy doctor instructed the nurse to inject Imanae with the third injection. All in all, 5mg of this anaesthetic/pain killer was given. This was the moment when the little baby went silent and started losing consciousness. Just before she totally passed out, she started calling out her father's name and saying that everything was getting blurred and she couldn't see clearly. Little did he know that these were the last words her daughter would ever say.

The parents asked the doctor what was happening to their daughter; he assured them that she was fine and was just sleeping, and left the room. They weren't satisfied and they checked Imanae themselves to see if they could feel her breath or hear her heartbeat. When the father couldn't feel either of the two, he immediately informed the nurse. She called the doctor again, who used a heartbeat monitor to examine Imanae. There was no reading on the monitor. He asked the doctor what this signified, and the doctor told him that since the monitor was intended for adult use, it could not detect his child's heartbeat. (This raises the question of why it had been used on a child in the first place.)

At this point, some other doctors on duty at the hospital joined him. They connected Imanae to an ECG machine, but this too also only reported a straight line. The parents asked why the line was straight, but the doctors did not reply. They kept on stating that she was fine and was just having some breathing problems. All the doctors started conferring between themselves as they continued to examine the girl. They continued to ignore the repeated pleas of the parents about what was happening to their daughter. They then started giving her CPR and it was at this point the father realised that his girl's life was in danger. The doctors, however, kept reassuring them that she was fine. They continued conferring between themselves, and the father was certain that something had gone horribly wrong. Another twenty or so minutes passed in this torture and confusion. They continued to reassure the parents that the child was fine! (If the child had been 'fine' there would have been a pulse on the ECG machine. Why was there no heartbeat? Why were they giving her CPR?)

Finally, one of the doctors told the father that the girl was having difficulty breathing, and because the hospital did not have a baby ventilator, the girl would need to be taken to a different hospital before her condition worsened. The father asked them for an ambulance because she was connected to all kinds of machines, but the parents were told that the ambulance was not available. If they wanted one they would have to wait for half an hour! (By way of a reminder, we should stress that the baby was not breathing at this point.)

The father decided to take his dying Imanae in his own car, and pleaded with them to give him a doctor to accompany them to a children's hospital. He did not know what was wrong with her and wanted someone to come along and explain exactly what her condition was. He wanted a list of injections and other medicines that had been given to her, to give to the doctors at the children's hospital. Furthermore, he wanted a copy of her ECG report… Nothing was supplied; and a ward boy was asked to go along. It took parents fifteen minutes to reach the children's hospital, where they were told that their three year-old daughter – their only child – was dead.

As with the previous example of Ahmad, the example of Imanae displays a catalogue of errors that led up to a disaster. What had started with a painful but non-life-threatening burn on a child's skin, ended up with her early death, via a series of medical blunders (and possible inebriation) and a system that had not been set up for the care of a child, either in terms of the equipment required or the medical expertise that was certainly lacking.

The death of a young child is of course an extremely emotive subject. It has been important, while presenting this example, to emphasise that we are not on a witch-hunt to bring a drunken doctor to justice (if this was indeed truly the case). What lessons can be learned? At the very least, the medical team should have been able to care for a three

year-old, we might well argue; but let us look at the repeated application of medication, the time-wasting, the total absence of customer care or any sign of a bedside manner.

Example 3: Africa/Italy

Ekaite was barely fifteen years old, in high school education, and living with her parents in a village by a river. She hoped to become an accountant. One day, a woman from Italy arrived in their village and, on seeing the poor conditions of life in the village, promised Ekaite's parents that would sponsor their daughter's education abroad. The parents agreed, hoping that she would become a responsible person in life and would be able to take of them and her siblings. Immediately the women gave the parents some money (approximately £150) and she took Ekaite to Lagos, where the necessary documentation was completed for the travelling plan. When she arrived in Italy, the woman collected all her documents, made her swear an oath not to tell anyone about whatever might happen to her, and demanded that call her Madam. Ekaite was not the only girl taken to Italy during this period; all of them were lured into prostitution.

At first Ekaite resisted, screaming, crying, and fighting off perspective customers, but she could not resist for long. The first time she was raped, the pain was so severe that she lost consciousness and had to be hospitalised for a week. Her parents had no idea of what she was going through, and Ekaite did not have the courage to tell them when she was allowed to speak on the phone with them. She was made to work from seven in the evening to five in the morning, with three or four clients every night; all the money was paid to the Madam. After a few months she was pregnant and the Madam carried out an illegal abortion.

When Ekaite was 21 years old, she was sick for several weeks. Finally, when she was taken to the clinic, she was diagnosed HIV-positive. Immediately she was returned back to Africa, with nothing. She found her way home, but she was rejected by her parents and by the other people in the village: because she was sick. Ekaite lived in the rehabilitation home for HIV/AIDS victims in the state capital. The Madam was charged in court by Ekaite but she was able to escape the proper judgement that was to be passed on her, because of her social influence. She suffered from depression after the Madam was able to do away with the court rule, before she finally committed suicide.

Commentary

Of course there are many more examples. Other case studies have involved the issues of barometric surgery – the removal of part of the stomach for children who are over-

weight – in a case in which the child was *not* overweight: the parents simply wanted the child to be thinner because she would be more saleable as a commodity. Another example would be the child whose parents wanted her to have plastic surgery so that she would be more attractive. The surgeon did not want to carry out the operation because the child was only ten, so the parents took her to another surgeon. The second surgeon agreed to the work in secret (and for a fee) but the child died while under the anaesthetic.

There are many case studies involving cell 'cloning', and the corresponding issues concerning the rights that a child born as a genetic copy of another have. (A clone's DNA is exactly the same as that of the original organism: not only is there the ethical consideration of whether cloning is humanly worthwhile at all; we must also consider the future of the one cloned.) However, in order ethically to present such material as part of our problem-based learning, it is also ethically appropriate to present both sides of the argument, as ever. It's an answer to infertility, claim supporters; the procedure might enable those who are unable to pass genes to future generations to do so in a way that is at least analogous to the familial linkage of twins. The procedure's detractors might speak (in return) of miscarriage, or deformed offspring; certainly there are likely to be many errors before there are successes in the field of study that will (in all likelihood) eventually produce the first cloned baby.

All of these examples share common factors. The very nature of problem-based learning (indeed a dictionary definition of the same) ensures that we are almost certainly focusing on a piece of bad news, in one form or another. Something has gone wrong – perhaps catastrophically – and it is our task, not to pass judgement on whose fault it was (often this is obvious, but not always), but to hammer out a theoretical means by which the bad news might be avoided in the future. As educators in this process, it is fair to assume that we will frequently play the role of a conversation facilitator, a mentor, perhaps, and not the more traditional role of a 'lecturer' (Mierson 1998). Having paid due caution to aspects of ethical consideration, such as privacy, we gently lead the learner into a world of constructivist pedagogies: it is the learner's own responsibility to find his or her way back out again.

To a large extent it is not an educator's role to dictate that X (or anything else) is *ethical* – or by implication that Y is *not* ethical. Rarely are matters so cut and dried; and besides, to an equally large extent, learners working together will form their own ethics: they will work together to build what might be called a group conscience. In the words of Money-Kyrle (1961: 123), 'a conscience in the members of a group is usually in the interests of the survival of the group' and 'since conscience is a product of the inner world, we must expect to find different kinds of conscience to be linked with different kinds of inner world' (124). In other words, it becomes almost axiomatic that in discussing ethical issues in problem-based learning, we must be ethical in our

pedagogic approach; in turn, the learners working through issues of ethics use systems of constructive alignment to develop their own ethics systems, while engaged in the task at hand.

Concluding remarks

The ethical issue of whether this form of learning is the most suitable for our learners should never be far from our consideration. Where there are emotive problems to consider, there is often learner anxiety; and whether the course is delivered in person or online, the educator is the usually the first contact with any learner suffering from anxiety as the result of what has been taught or presented. The specific contributions of the personal tutor are beyond the scope of this paper (but will follow in due course), but whether the educator agrees with the matter or not, the same educator is expected and must be prepared to console or support the learners who become upset. And of course this is a contentious point – the point at which our role as educator ends and someone trained in psychological matters should take over – but disagreeing with it will not make it go away. (We might even argue that there are ethical considerations in *allowing* educators to present material that is likely to spur on crying and/or anxiety. At what point is such an approach counter-productive? Unfortunately, this question is also beyond the scope of this particular paper.)

Right from the very beginning, when this programme was being developed, we were aware that there were Big Questions that we needed to address (Sapsed and Mathew 2011). Not only was there the thorny issue of how to avoid what we knew must be avoided (we did not wish to build a learning resource that consisted of simple reading exercises, with nothing to enrich the experience), we knew that we had to take on board the fundamental recognition that health education is fraught with ethical, sometimes controversial, frequently complex issues that might benefit from intellectual interaction and either face-to-face or online debate.

Worldwide, many subjects have been brought alive by distance learners in the way they use the new technology. Even the process of communication between lecturer and student can be improved by distance learning: the educator takes a more considered time before responding, rather than make a comment that in other contexts might be regarded as cursory. The educator feels that the student should be self-empowered to take charge of his/her own learning at Masters level. Indeed, one of the key purposes of Higher Education is to facilitate the autonomy of learners. To this end we argue that the facilitation of the autonomy of our learners is an important product of our work with problem-based learning, in which matters of ethical concern have been both thought out beforehand and are addressed as they arise during the programme.

References

Albanese, M. A., and Mitchell, S. (1993) Problem-based Learning: A review of literature on its outcomes and implementation issues. *Academic Medicine 68*, 52 – 81.

Coles, C. R. (1991) Is problem-based learning the only way? In D. Boud and G. Feletti (Eds.) *The Challenge of Problem-Based Learning* (p. 295-307). London: Kogan Page.

Cruickshank, B. J., and Olander, J. (2002) Can problem-based instruction stimulate higher order thinking? *Journal of College Science Teaching 31* (6) 374 – 377.

Michel, M. C., Bischoff, A., and Jakobs, K. H. (2002) Comparison of problem- and lecture-based pharmacology teaching. *Trends in Pharmacological Sciences 23,* 168 – 170.

Mierson, S. (1998) A problem-based learning course in physiology for undergraduate and graduate basic science learners. *Advances in Physiology Education 275* (supplement) S16 – S27.

Money-Kyrle, R.E. (1961) Man's Picture of His World. London: Duckworth.

Ryan, G. L., and Quinn, C. N. (1994) Cognitive apprenticeship and problem based learning. In S. E. Chen, R. Cowdroy, A. Kingsland, and M. Ostwald (Eds.) *Reflections on Problem Based Learning* (p. 15-33). Sydney: Australian Problem Based Learning Network.

Sapsed, S. And Mathew, D. (2011) The Growth of the Public Health Masters at the University of Bedfordshire. Refereed Program of the E-Leader Conference at Zagreb, Croatia, ISSN 1935-4819. New York: Chinese American Scholars Association.

Shannon, S., and Brine, J. (1994) Consolidating professional skills and developing the confidence of graduating architects. In S. E. Chen, R. Cowdroy, A. Kingsland, and M. Ostwald (Eds.) *Reflections on Problem Based Learning* (p. 201-217). Sydney: Australian Problem Based Learning Network.

ICT in problem-based learning – potentials and requirements from an instructional psychology point of view

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Introduction

The use of information and communication technology (ICT) in Problem-based Learning (PBL) has been discussed and analysed for a long time. Potential use of ICT are considered especially for the problem presentation, the promotion of student communication and collaboration, for the individual tutoring and for the assessment (Ronteltap, 2006, Donkers et al., 2010, Hallinger, 2005, Uden & Beaumont, 2006). In addition, it is hoped that ICT may help to organise the learning and coaching process in PBL more efficiently; in particular, ICT can overcome or at least mitigate the resource limitations in degree programs with very high student numbers, especially concerning tutoring and supporting the learning process in the small study groups (Roberts et al., 2005, Pastirik, 2006). The previous reflections on ICT in problem-based learning are characterised by a strong technology approach focusing on how to use the latest ICT technology in PBL, rather than analysing the demands of PBL upon the design and features of ICT from an instructional psychology point of view. To address these issues, PBL is first analysed from a cognitive and motivation psychology point of view and then design principles for effective and efficient learning with PBL are derived. Based on these principles, the areas of potential for an effective ICT-support of the learning process and organisation in PBL are identified and respective requirements for ICT are defined. This catalogue of specification is designed to determine which ICT tools and specific functions are appropriate for effective electronic PBL learning environments.

Instructional psychology analysis

The following cognitive and motivational psychology analysis focuses on potential concerns in the PBL learning process. The aim is not to critique PBL as a learning approach in general. The recent debate about constructivist instruction (Tobias & Duffy, 2009) has revealed that learning approaches have their respective strengths and weaknesses, suggesting one must use learning approaches flexibly according the specific objectives of the learning context, and not to restrict oneself dogmatically to one learning approach. It is understandable, for example, that for highly stable learning content, such as typing, direct instruction approaches may be more effective and efficient than learning approaches such as PBL, where exploration has a high priority (Schwartz et al., 2009). In contrast, PBL has proven by meta-evaluations (Strobel & Van Barneveld, 2009) to be particularly suited for the integrative and sustainable promotion of (vocational) capacity building (technical skills as well as social and personal skills).

Cognitive psychology aspects

In PBL, a problem serves as starting point of the learning process. Often, complex and poorly structured problems are recommended for PBL. However, these problems designed by teachers are not necessarily perceived as complex or authentic by the students (Clark & Elen, 2006). Rather, the learner can only perceive the situation that he himself understands due to his personal experience, judgment, specific knowledge, but also learning interests. Thus, the structure of a problem or learning environment may be described by the teacher as complex and authentic, but for the students, due to their individual selective perception and subjective interpretation, it may at best be unconstructed, not transparent and confusing. Thus, the subjective perception of the problem in the context of the PBL learning cycle will lead to individually different problem detection and initiate individually specific learning processes. There is a risk in PBL that due to the individual subjective problem understanding not the learning processes intended by the teachers are initiated, and the students only partially or may even fail to come into contact with the intended curricular objectives (Mayer, 2004). The amount of study time in general has been found in various studies as a key determinant of learning success (Berliner, 1984). However, what it is more crucial than the amount of time is how the study time is actually used (Bransford et al., 2000), i.e. whether appropriate cognitive learning processing in terms of selection, organization and integration of knowledge can be triggered. The learning process of PBL can require significant time resources for organizational learning activities (learning organization in small groups, literature research, etc.), which are only limited or not connected with the intended cognitive processing of the intended academic objectives. Because PBL's goal is not only to increase technical competencies, but to enhance social and personal skills, what matters most is how much learning time is

provided and actually needed for the different learning objectives. For example, the independent literature review is an important educational goal on the tertiary education level, but it is questionable whether in all PBL modules a large part of the time resources should be spent on that goal. Instead, this goal may be focused in some PBL modules and in others, a selection of basic literature and learning material could be provided. Although, the learning efficiency is only a minor issue in the literature, it has considerable importance for teachers and students in practice.

Because of the freedom in the choice of the learning content and the design of the learning process, PBL is subject to the risk of *under-directing the learning process*: Students in PBL may not or not sufficiently work directly with the intended academic objectives. Therefore, cognitive processing of the learning content may be compromised. To mitigate the risk of under-directing, the appropriate amount of guidance is central. Organizational and instructional support should be adapted to the students' abilities and learning objectives. This may help prevent students' confusion and improve the learning efficiency of PBL. Examples of organizational measures are the detailed planning and organization of the learning process (e.g. preparation of small-group sessions), the use of (electronic) cooperation and communication scripts and tools (e.g. learning management systems), or the simplified access to learning materials (e.g. provided readers or bibliography). With scaffolding, as one method of instructional guidance, teachers can support students, based on the problem and the existing knowledge, to achieve their learning objectives. In addition, the flexible use of other instructional methods for an efficient information transfer may be appropriate at a certain stage of the PBL learning process. For example, if students deal with a problem and are confronted with the need for particular kinds of knowledge, it may be beneficial to flexibly integrate a lecture in the PBL learning process (Hmelo-Silver, 2004). It is worth stressing that there is an important difference between lectures in traditional curriculum to lectures in PBL: Students in a PBL learning approach realize exactly why a lecture is necessary, and thus are motivated to try to understand it to the best of their ability in order to address their current learning objectives (Taylor & Miflin, 2008).

In recent times, authentic and complex problems as the starting point of the learning process in PBL have been controversial when discussed in connection with cognitive load theory (Tobias & Duffy, 2009). The cognitive load theory (Sweller, 1994) assumes that the conscious cognitive processing takes place in working memory, yet, working memory is limited with respect to the volume of information and the length of time it can be held, and the number of operations it can perform with that information. The cognitive load of a learning environment should not exceed working memory resources, otherwise, there will be a *cognitive overload* and the learning process will be inhibited, or actually prevented (Paas et al., 2004). However, the limitations of working memory are only valid for new information that must be learned and that is not already stored in long-term memory. This limitation disappears when learned infor-

mation is retrieved from the long-term memory as schemata and treated as a single element in working memory. This can also explain why experts with vast knowledge stored in long-term memory can solve highly complex problems that overwhelm novice students because of the limitations of working memory. Authentic and complex problem situations in PBL include a considerable amount of irrelevant and redundant information in order to make the problems realistic (extrinsic cognitive load), which poses the risk of cognitive overload (Van Merrienboer & Sweller, 2005). This may be especially detrimental to learning in the case of novice students, who lack proper schemata to integrate the new information with their prior knowledge (Kirschner et al., 2006). To avoid cognitive overload in PBL, the difficulty of the problem should conform to the expertise level of the students, i.e. should be within the students' zone of proximal development (Vygotsky, 1978). In the case of novice students, cognitive overload can be avoided by reducing extrinsic load by avoiding redundancy and split-attention effects. Additionally, in order to support cognitive processing (increasing the germane load) for these students, teachers can integrate key questions into the problem situation.

An additional risk in PBL is that the curriculum is often not oriented and sequenced according the common structure of a discipline, but in learning or problem areas. This complicates the cognitive development of a current discipline knowledge structure. Consequently, the students may have difficulties in integrating new information into prior knowledge. When designing the curriculum and the learning modules particular care needs to be taken to sequence the problems in a way that allows students to build upon their knowledge step-by-step in a well-structured way (Taylor & Miflin, 2008). This may facilitate the integration of new knowledge into prior knowledge.

According to the situated cognition approach, knowledge is acquired situationally, and transfers only to similar situations (Anderson et al., 1996). Since knowledge is learned in an authentic problem situation, PBL fulfils one essential condition that knowledge can be used in practice and which prevents inert knowledge. However, for sustainable learning, which allows an effective transfer of knowledge and skills to as many application situations as possible, the processing of several problems in various situations is necessary.

Motivational psychology aspects

The above findings of cognitive psychology focus on cognitive aspects of information processing. Yet, they neglect emotional, motivational as well as meta-cognitive aspects of learning that are particularly important in order for one to solve complex problem situations (Mayer, 2004). There are various theories and models for learning and motivation, and each of these theoretical approaches focuses on specific aspects of motivation. Thus, for the explanation of motivation as a result and determinant of school

learning, it is necessary to combine different theoretical approaches. To classify the different forms of motivation in an educational focus, the extended cognitive model of motivation (Rheinberg et al., 2000) is suitable. In the model, two different types of motivational incentives are distinguished: activity-specific incentives and incentives from future events. The two types of motivation triggered by these incentives correspond to the popular concept of intrinsic and extrinsic motivation. From the relevant theories and models on motivation, Müller (2007, 2008) has derived relevant characteristics and conditions, presented below, that promote motivation in learning environments.

Table 1: Characteristics and conditions for motivating learning environments

Extrinsic Motivators	**Self-directed and self-controlled goal learning (Rheinberg et al., 2000)**
	• Show the results of the learning effort • Demonstrate the positive effects of the learning outcomes, such as examination success, graduation, career success, significance for professional practice • Base assessment mode on the individual learning effort and learning outcomes and show learning effects • Avoid aversive learning activities (e.g. memorization, tedious literature research etc.) • Promote self-regulation skills
Intrinsic Motivators	**Self-determination Theory (Deci and Ryan, 1985)**
	Competence-enhancing learning conditions • Challenging, practical life tasks and problems with a reasonable degree of difficulty • Frequent (positive) feedback and affirmations, using a criteria oriented and individual reference norm • Fault tolerance (particularly for new tasks) • Appropriate social support *Autonomy-promoting learning conditions* • Enable participation and expand the students' scope of action (in terms of learning objectives, learning organization and coordination, learning outcomes and assessment) • Couple the learning content to meaningful life goals and skills *Relatedness-enhancing learning conditions* • Learning and working in teams • Teacher-student relationship as a good partnership (communicate appreciation, recognition, and real interest, instil confidence in students)
	Interest Theory (Krapp, 1999)
	• Emphasize the relevance of the learning content (show application context) • Link the learning content with ‚natural' interests and experiences of the students (e.g. by using authentic materials) • Vary the design of the learning environment (e.g. by varying the social form and teaching materials) • Foster epistemic curiosity by giving opportunities for choice and specialization • Expressing interest for the content by the teacher • Increase the emotional content of intended academic objectives
	Flow Theory (Csikszentmihalyi, 1975)
	• Fit between the learner's abilities and the complexity of the learning environment • Clear communication of learning objectives, assessment criteria and expectations • Frequent feedback on accuracy of the learning activities • Minimal disruption of the learning activities

Various structural features of PBL, such as the authentic problem situations with references to the personal and (future) work life of students, the social embedding of learners in small groups of students, the opportunities for choice and specialisation regarding learning objectives, or the possibility to take responsibility for the learning process, meet the above characteristics and conditions for enhancing students' intrinsic motivation. Many studies have shown that PBL can have a beneficial effect to students' motivation and satisfaction (Strobel & Van Barneveld, 2009). However, if and to what extent a particular PBL learning environment has positive effects on the student's intrinsic motivation, depends on the specific design of PBL. It is particularly important, to adapt the complexity of the problem situation to the students' prior knowledge and abilities, to structure and sequence the learning process in a meaningful way, and to support it effectively (feedback on the learning process and outcomes). It is questionable whether there is enough methodical variety in a fully integrated PBL curriculum, to maintain students' motivation over time. In some studies a motivation drop was observed, when a complete training course is methodically designed with PBL (e.g. Moust & Roebertsen, 2010). Although, PBL includes several features that encourage self-initiative learning, it is unlikely that through PBL (or any one design of the learning environment) all students are sufficiently motivated intrinsically to take on learning activities of their own now and in the future. For this reason, extrinsic incentives for self-directed and self-controlled learning with an assessment system that fits to the learning culture are also necessary. From a motivational psychology perspective it is often effective to include individual as well as group performance in the assessment. In that way, incentives are provided for the students to engage for the benefit of the group, as well as to strive for individual success. Misdirected or inadequate assessment incentives can lead to disengagement of mainly extrinsically motivated students and are often the source of dysfunctional group dynamics and demotivation.

Design principles for problem-based learning

From the above analysis, it is possible to derive key issues for the design of PBL learning environments. The following aspects are important and should be considered from an instructional psychology perspective.

Table 2: Design principles (DP) for PBL from an instructional psychology perspective

Problem design
1. *Structured and sequenced curriculum*: The acquisition of technical, social and personal skills has to be structured and sequenced coherently, so that the students are able to develop well elaborated and structured knowledge and skills.
2. *Adapted complexity*: The complexity of the problem situation has to be optimally matched to the students' level of expertise.
Learning organization
3. *Detailed planning and organization*: The cognitive time-on-task should be kept high (unless technical skills have priority). Detailed planning and organization of the learning activities can support this.
Learning Resources
4. *Appropriate learning resources*: Adequate learning resources for the students' competence level and the complexity of the problem situation are provided.
5. *Flexibilization of skills*: To improve the flexibility of the acquired skills, there are other problems and application tasks in different contexts at the students' disposal.
Tutoring
6. *Individual coaching*: The different learning processes triggered by the problem situations are accompanied and supported as individually as possible (using scaffolding, etc.).
7. *Appropriate guidance*: The learning process is guided appropriately to the students' level of competence.
Assessment
8. *Differentiated feedback*: Students get frequent and differentiated feedback on the level of their competences (technical, social, personal competences).
9. *Incentive-compatible assessment*: The assessment system creates incentives for students to engage in learning activities individually as well as in groups.

The fit between the complexity of the learning environment and students' competence level appears to be essential both from a cognitive as well as from a motivational psychology point of view. Teachers can adjust the complexity of a PBL learning environment in particular through the design of the problem and by the degree of support. In practice, the design of an optimal complexity of the problem situation is a challenging task, especially if the group of students has a heterogeneous level of competence. Furthermore, the instructional support has to be adjusted to the expertise level of the students. PBL creates open learning environments, which allow students to follow individual learning paths. On behalf of the learning effectiveness and efficiency they need to be bounded with suitable didactic and methodological measures and supported with appropriate instructional and organizational measures. In the current debate about constructivist instruction (e.g. Tobias & Duffy, 2009) all proponents have highlighted the central function of an appropriate guidance and customized support of the learning process. This position was also confirmed by a recent meta-evaluation of constructivist instruction (Alfieri et al., 2011). The ability of the teachers to anticipate the students' learning paths and to plan their didactic and methodological measures accordingly has been shown as an important prerequisite

for the effective design of a PBL learning environment (Müller, 2007). When designing the PBL learning environment, the teachers consider which learning paths may be initiated through the problem situation and possible framing conditions, what kind of difficulties in understanding may occur on the individual learning paths, and which learning resources and activities are needed at a particular time to lead the learner to a specific solution space. This design process, in which the learning environment is meticulously planned almost as if it were a screenplay, may be referred to as scripting.

The above discussion shows that the design of a PBL learning environments is challenging and time-consuming: The curriculum has to be structured and sequenced, the authentic and complex problem situations must be developed appropriate to the students' level of expertise, the learning process must be planned in detail and has to be communicated to the students, appropriate learning resources and forms of formative and summative assessment must be prepared, and in the context of scripting, the whole learning process has to be anticipated and appropriate instructional interventions to be arranged beforehand. During the PBL learning process, the groups and individuals must be accompanied and supported in their learning process, situational learning resources must be made available, and different forms of assessments and feedback must be carried out. It is not astonishing that many studies (e.g. Anderson & Glew, 2002, Hallinger et al., 2005) point out that the implementation of PBL imposes high demands on the staff and requires considerable time resources. The high workload of PBL is also often an issue for teachers directly working in the classrooms.

Requirements of ICT for problem-based learning

The design of PBL can be supported by ICT on two different ways: Primarily ICT can offer new features to make the learning process more effective; in addition, ICT can also support teachers in their functions and thus make their support more effective and efficient. Thus, the workload of the teacher can actually be reduced. Based on the design principles, it will be investigated which requirements have to be fulfilled by ICT to support PBL effectively. Concerning the fit between the complexity of the learning environment and students' competence level, ICT can assist the PBL learning process in various ways. With electronic adaptive testing it is possible to identify the level of competence of the learners, thus the problem situations can be adapted correspondingly, and information and learning resources can be provided in a sequenced and adaptively manner according to the level of their competence (DP 2 and DP 4). By using tests during the learning process in a formative way, students also get immediate feedback about their learning process and performance (DP 8). ICT also supports differentiated assessment and evaluation of learners. For example, the assessment of social and communication skills is a challenging and time-consuming

task for teachers. With ICT, students' self- and peer-assessment can be automated by evaluating themselves and each other after completion of the PBL learning process electronically and by getting a personalized electronic feedback (DP 8). Feedback on the quality of the learning progress and the performance help learners to reflect upon their learning strategies. From a metacognitive point of view, insight into the learning process as well as seeing products from the other study groups may be helpful. With ICT, the learning process can be structured, and information and learning resources (such as solutions from other groups or reference solution) can be disclosed adaptively after the completion of certain steps (e.g. upload of one's own solution). Conditional access to learning materials makes sense in such a context because with unlimited access there could be a temptation to accessing the solution before proper reasoning of one's own. The completion of the PBL learning process could be sequenced similarly to the following example:

1. Upload learning product (e.g. problem solution) on the server (in group)
2. Access to solutions from other groups (or reference solution) (in group)
3. Reflection upon own and other group solutions (in group)
4. Feedback to other groups (in group)
5. Work on other related problem situation for flexibilization of the skills (alone or in groups)
6. Electronic competence test(s) (alone)
7. Electronic self- and peer-assessment (alone)
8. Access to personalized performance feedback (tests and peer-assessment)

The progress is checked by the system and students only have access to the next step if the previous ones have been completed. In addition, the learner can be invited electronically to a certain step (e.g. peer-assessment). In this way, ICT can help in guiding and controlling the learning process; tasks that are very time-consuming for teachers (DP 7). In addition, the teachers have access to the learning process and products via computer documentation of the learning groups and individuals, independent of time and place, and can respond immediately and flexibly. In this way, the individual coaching of the learning groups with scaffolding (DP 6) and the provision of learning resources (DP 4) can be better tailored to the needs of the learners. This may be especially effective if - for reasons of limited resources - not all study groups are accompanied by a qualified tutor on site. ICT can also facilitate the flexibilization of the skills through the electronic provision of further problems including feedback system (DP 5). In addition, ICT can also support efficient planning and organization of the learning process by making information available online, or by using an electronic agenda (DP 3). In particular, the group organization can be made more efficient, and thus, the time-on-task during the PBL sessions could increase. Electronic surveys may also helpful in assembling the group membership in accordance with certain criteria, such as level of competence or learning strategies (e.g. Sancho et al., 2011).

The analysis and the examples above have demonstrated that adaptive ICT systems have the potential to assist with challenges of PBL, such as the risk of under-directing the learning process or the risk of cognitive overload effectively. In addition, a sophisticated electronic assessment and feedback system can improve the assessment system and reduce incentive problems. Furthermore, ICT also has the potential to augment the strengths of PBL, for example, by presenting problem situations with multimedia more authentically, by giving electronic opportunities to collaborate and communicate independent of time and location, and by enhancing reasoning and understanding with tools for modelling and visualisation. Table 3 summarizes the requirements for ICT in PBL from an instructional psychology perspective.

Table 3: Requirements for ICT in PBL from an instructional psychology perspective

Problem situation
1. Problem situations can be presented with multimedia (video, audio, video, etc.).
2. Information can be sequenced and disclosed automatically and adaptively.
Learning organization
3. A flexible (sub)group formation based on certain criteria is possible.
4. Communication independent of time and place (synchronous and asynchronous) is possible.
5. A collaboration supporting electronic documentation of the learning process and learning products (joint editing of documents, etc.) is possible.
6. A calendar function for scheduling is available.
Learning Resources
7. Learning resources can be made available in various formats (mini-lectures, etc.).
8. Tools to model and visualize reasoning (casual mapper, modelling, 3D visualization, etc.) are available or can be integrated.
9. Flexible and adaptive (conditional) access (for groups, students, etc.) to learning resources and products can be defined.
Tutoring
10. Electronic insight into the working process and the learning products of the learning groups and individuals is possible.
11. There are options for flexible communication with individual students, small groups, and the whole group.
12. (Individual) learning paths (with milestones, deadlines) including automatic feedback on the status of the learning process can be defined.
Assessment
13. An (adaptive) test system can determine the competence level of the learners.
14. A variety of electronic assessment tools (including e-portfolio) for formative and summative assessment of learning outcomes (technical, social and personal skills) are available.
15. An electronic system for individualized, automatic feedback including solution tips or reference solutions is available.
16. There are opportunities for peer feedback, including individualized and anonymous feedback.

This catalogue of specification shows which ICT tools and specific functions are appropriate for an effective electronic PBL learning environment. It may be helpful in designing electronic PBL learning environments or choosing of a suitable existing learning platform (LMS) for PBL.

References

Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2011), Does Discovery-Based Instruction Enhance Learning?, *Journal of Educational Psychology,* Vol. 103, No. 1, pp. 1-18.

Anderson, J. R., Reder, L. M., & Simon, H. A. (1996), Situated Learning and Education, *Educational Researcher,* Vol. 25, No. 4, pp. 5-11.

Anderson, W. L., & Glew, R. H. (2002), Support of a problem-based learning curriculum by basic science faculty, *Med Educ Online,* Vol. 7, No. 10.

Berliner, D. C. (1984), The Half-Full Glass: A Review of Research on Teaching, In Hosford, P. L. (Ed.), *Using What We Know About Teaching*, pp. 51-84, Virginia: Association for Supervision and Curriculum Development.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000), *How people learn: brain, mind, experience, and school*, Washington: National Academy Press.

Clark, R. E., & Elen, J. (2006), When less is more: research and theory insights about instruction for complex learning, In Elen, J. & Clark, R. E. (Eds.), *Handling complexity in learning environments: theory and research*, pp. 283-298, Amsterdam: Elsevier.

Donkers, J., Verstegen, D., Leng, B. d., & Jong, N. d. (2010), E-learning in problem-based learning, In Berkel, H. J. M. v., Scherpbier, A., Hillen, H. & Vleuten, C. v. d. (Eds.), *Lessons from problem-based learning*, pp. 117–128, Oxford: Oxford University Press.

Hallinger, P. (2005). *Integrating learning technology and problem-based learning: a framework and case study.* Paper presented at the American Educational Research Association, Montreal.

Hallinger, P., Blackwood, A., & Tannathai, P. (2005). *Implementing problem-based learning in higher education.* Paper presented at the American Educational Research Association, Montreal.

Hmelo-Silver, C. E. (2004), Problem-based learning: what and how do students learn?, *Educational Psychology Review,* Vol. 16, No. 3, pp. 235-265.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006), Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching, *Educational psychologist,* Vol. 41, No. 2, pp. 75-86.

Mayer, R. E. (2004), Should there be a three-strikes rule against pure discovery learning?, *American Psychologist,* Vol. 59, No. 1, pp. 14-19.

Moust, J., & Roebertsen, H. (2010), Alternative instructional problem-based learning formats, In Berkel, H. v., Scherpbier, A., Hillen, H. & Vleuten, C. v. d. (Eds.), *Lessons from Problem-based Learning*, pp. 129-141, Oxford: Oxford University Press.

Müller, C. (2007), *Implementation von Problem based learning: Eine Evaluationsstudie an einer Höheren Fachschule*, Bern: hep.

Müller, C. (2008), Gestaltung von problembasierten Lernumgebungen (Problem-based Learning), *Netzwerk,* Vol. 08, No. 1, pp. 20-33.

Paas, F., Renkl, A., & Sweller, J. (2004), Cognitive load theory: instructional implications of the interaction between information structures and cognitive architecture, *Instructional Science,* Vol. 32, No. 1, pp. 1-8.

Pastirik, P. J. (2006), Using problem-based learning in a large classroom, *Nurse Educ Pract,* Vol. 6, No. 5, pp. 261-267.

Rheinberg, F., Vollmeyer, R., & Rollett, W. (2000), Motivation and action in self-regulated learning, In Boekaerts, M., Pintrich, P. & Zeidner, M. (Eds.), *Handbook of self-regulation*, pp. 503-529, San Diego: Academic Press.

Roberts, C., Lawson, M., Newble, D., Self, A., & Chan, P. (2005), The introduction of large class problem-based learning into an undergraduate medical curriculum: an evaluation, *Medical Teacher,* Vol. 27, No. 6, pp. 527-533.

Ronteltap, F. (2006), Tools to empower problem-based learning: a principled and empirical approach to the design of problem-based learning online, In Savin-Baden, M. & Wilkie, K. (Eds.), *Problem-based learning online*, pp. 174-190, Maidenhead: Open Univ. Press.

Sancho, P., Torrente, J., Marchiori, E. J., & Fernandez-Manjon, B. (2011). *Enhancing moodle to support problem based learning. The Nucleo experience.* Paper presented at the IEEE Global Engineering Education Conference (EDUCON 2011), Amman (Jordan).

Schwartz, D. L., Lindren, R., & Lewis, S. (2009), Constructivism in an Age of Non-Constructivist Assessments, In Tobias, S. & Duffy, T. M. (Eds.), *Constructivist instruction : success or failure?*, pp. 34-60, New York: Routledge.

Strobel, J., & Van Barneveld, A. (2009), When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms, *Interdisciplinary Journal of Problem-based Learning,* Vol. 3, No. 1, pp. 44-56.

Sweller, J. (1994), Cognitive load theory, learning difficulty, and instructional design, *Learning and Instruction,* Vol. 4, No. 4, pp. 295-312.

Taylor, D., & Miflin, B. (2008), Problem-based learning: Where are we now?, *Medical Teacher,* Vol. 30, No. 8, pp. 742-763.

Tobias, S., & Duffy, T. M. (2009), *Constructivist instruction: success or failure?*, New York: Routledge.

Uden, L., & Beaumont, C. (2006), *Technology and problem-based learning*, Hershey, PA: Information Science Pub.

Van Merrienboer, J. J. G., & Sweller, J. (2005), Cognitive load theory and complex learning: recent developments and future directions, *Educational Psychology Review,* Vol. 17, No. 2, pp. 147-177.

Vygotsky, L. S. (1978), *Mind in society*, Cambridge MA: Harvard University Press.

Competence and problem-based learning in practice – experiences from higher education in human resources management

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Introduction

Our purpose in this paper is to describe our learning experiences of a Problem-Based Learning (PBL) pilot study unit, which we designed and implemented as a pedagogical approach for Master's students in Rovaniemi University of Applied Sciences (RUAS) during the autumn semester of 2011. We highlight pedagogical practices and the value of multiple learning environments, in particular, virtual learning environments in the context of strategic human resources management for Graduate level students of Engineering in our School of Technology.

This article focuses on three angles in the understanding and development of PBL: arrangements and practices of PBL with a particular emphasis on versatile use of technology and virtual learning environments; participatory co-learning within a solid working life – education relationship; and learning processes and outcomes of Master's students and tutors.

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In addition to reflecting on the lessons learned and to capturing the key success factors for the implementation of PBL within adult education, this paper highlights the need for a more extensive use of participatory and student empowering pedagogies in (human resources) management education. By following the thoughts of Coombs and Elden (2004, 532), we particularly aim to contribute to the shortfall of PBL-based empirical analysis in the field of higher education and wish to promote the emerging paradigm shift of pedagogical arrangements in management education.

Our article is structured as follows. After this introductory chapter, we will discuss our pilot study unit experience in the second chapter, which is divided into the planning, execution and assessment phases of the pilot. Then, in our final part we will present and discuss the results of our study based on student feedback, after which we conclude the implications of our pilot study unit.

Pilot study unit experience

The basis for the Pilot Study Unit was the need for a pedagogical reform detected during the renewal of RUAS strategy work in 2009. As a consequence, the board of RUAS decided in 2010 that the whole University and all its' Schools and Degree Programmes would start to implement exclusively PBL in 2013. Problem-based learning (PBL) is a pedagogical approach that has gained a rather established position in professional and higher education. For the needs of an increasingly networked, multi-cultural and complex working life it seems that pedagogical approaches and arrangements are shifting from a traditional behaviouristic takes towards more constructivist and participatory ways of learning (Zwaal & Otting, 2007). Indeed, companies and organisations call for graduates who can manage diverse everyday challenges with creative and collective problem solving skills, social skills, and competencies in organising, understanding and developing multi-sector networks.

In order to learn the PBL in practice, a group of Degree Programmes were chosen to test and run pilot study units and consequently convey the gained experience to other Degree Programmes of the University. In the School of Technology of RUAS the Degree Programme of Technological Competence was chosen to be the pilot Degree Programme. Degree Programme of Technological Competence was the only one of the six pilots in RUAS on the Master's level, whereas the others represented the Bachelor's level. Thus, the aim of our pilot was to construct knowledge on the EQF level 7 according to the European Qualification Framework.

The planning of the pilot study unit was started together with the representatives of local employers. Our first meeting in a form of a workshop took place early March, 2011. Our aim of the meeting was to define the competencies of a Master of

Engineering graduating from the Degree Programme of Technological Management. These competencies were formulated in a form of a Curriculum, which was jointly accepted by us, the designers of the pilot, and the representatives of local employers. By working in close contact with the working life representatives we were able to share ideas, give concepts to practical workplace phenomena and build trust and mutual understanding. This eventually played a significant role in establishing an inspiring but credible context for the study unit and the formulation of problems to be given to the students (see Sherwood, 2004).

Our second meeting with the local employers took place in May, 2011. In this second workshop with them we started to initiate the actual work life based problems, which we were planning to use in on the study unit to be implemented in autumn of 2011. The study unit chosen to be the actual pilot was Human Resources Management, a 10 credits large study unit. This study unit was a new one, and it consisted of two formerly independent study units; Leadership and Knowledge Management, both 5 credits. As a result of our workshop with the representatives of the local work life we had created real life problems to be presented to the students. Hence, the students would get to solve these problems collectively.

The next phase in our pilot planning process was to create a schedule for autumn period of 2011. This caused us some concern, because the students in the Degree Programme were studying in a professional Master's Programme and they were all employed outside the University. Thus, we had to figure out a schedule which would enable them to work and study simultaneously. On the other hand the students were our direct connection to the work life, and they could actually reflect on the curriculum and their teaching assignments at their workplaces together with their colleagues. Indeed, since adult education is highly working life oriented the emphasis is in developing competencies at work and constantly adapting new ways of working and learning. Additionally, since the students had a strong bond between their current work and their management studies, this also contributed to the building of a meaningful, real-life context for the work life oriented problem formulation and solving (see Sherwood, 2004).

However, as Sherwood (2004, 545) summarises in his framework for PBL context design, when planning the execution we also had to take carefully into account the background of the participants, the overall pedagogical and learning objectives, the social structure including the stakeholders (both the aforementioned working life representatives and the students' employers), and the technology to be used, in particular the ratio between the use of physical and virtual learning environments.

The execution of the pilot

The execution of our pilot study unit started in August, 2011 with an orientation lesson of PBL. We explained to the students how PBL works and showed and discussed the following procedure (see Figure 1) to them. This two (2) hour lesson was the only orientation we had for the students. However, in addition to the important PBL principles, we also paid attention in the briefing to students' epistemological beliefs and conceptions about learning and teaching (see Rinck de Boer & Otting, 2011). The next encountering of PBL for students took place in the first tutorial of the first cycle.

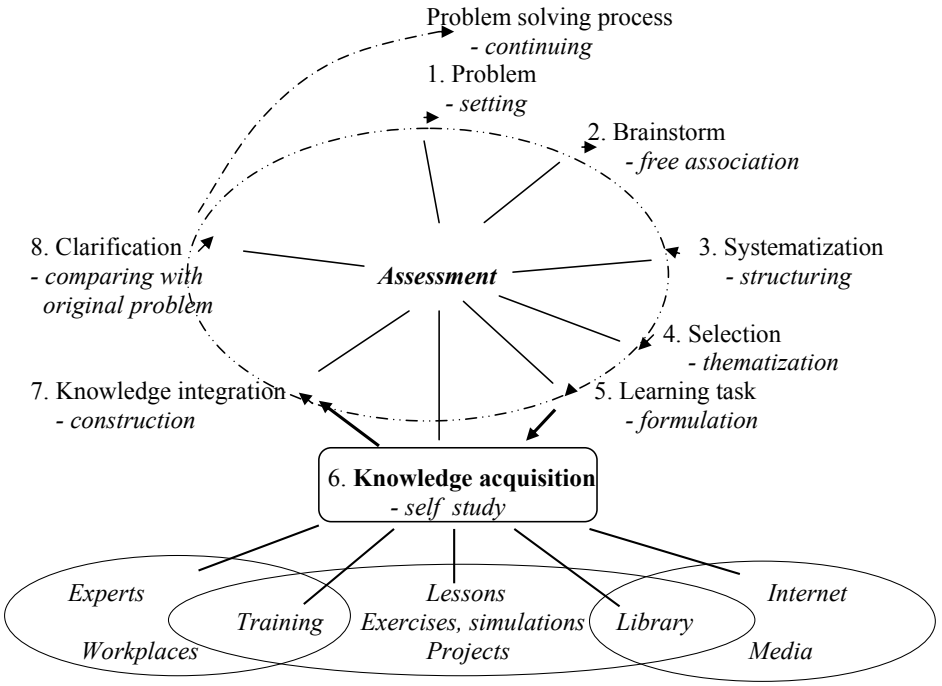

Figure 1. Problem-based learning cycle and knowledge acquisition (Poikela, E. & Poikela, S., 2006a, 78).

The first tutorial was arranged two weeks after the orientation lesson (e.g. in the middle of September 2011). From that moment on we worked according to our schedule, which was planned during the planning phase of the pilot. In average, one cycle was implemented in a three week interval. The pilot study unit lasted from September until December 2011. There were 21 students participating in our pilot. Their average age was about 40 years and the majority of the students were male. We divided the group into three subgroups and took part in the overall learning process as their three tutors (one author per subgroup).

Our solution to the special distance learning needs of our adult students was to use Social media as a platform for the communications. Social media is a process, in which the actors construct common meanings. This happens through content, networks and web-technologies. In social media the users are producers of the content. At the same time they are creating networks. A channel for such network can be a blog, a wiki or another internet site, which has been constructed using "web 2.0" technology. Tim O'Reilly has been named as the creator of web 2.0 technology. (O'Reilly, 2012.) Web 2.0 technology enables the communications of the producers and the users, in our pilot study unit case the interaction between the students themselves and their tutors.

PBL has evolved from its' beginning into different strands. In our pilot study we have focused on an open learning environment, which reformulates PBL somewhat differently. Our model of PBL was based on two main ideas. First of all, our version of PBL was focusing on competence development. Secondly, virtual tools were widely used to support learning. Thus, we can conclude that our PBL study unit was either competence and problem-based learning (CPBL) or due to the use of Social media, namely blog and wiki, an online-PBL or distributed PBL (see Savin-Baden, 2007; Wheeler, 2006).

Our pilot study unit consisted of rather broad scenarios (instead of narrow cases), for the adult students followed a three week cycle mode. The tutorials took place on a Saturday morning, when the students, some of whom were living in remote areas of Lapland, were visiting RUAS. Usually the ending tutorial of one cycle started at 08.00 and the beginning tutorial of another cycle followed at 10.00. In the afternoon of each tutorial Saturday there were expert lectures to the students on the themes of each teaching assignment. During the autumn of 2011 there were altogether five cycles and ten tutorials. Between the tutorials the students were using web-based virtual tools in their peer-to-peer and student-to-tutor communications. RUAS standard learning platform, Optima, acted as a starting point for students to gain information on the practical arrangements of the pilot study unit, from where the students could log on or sign in on other virtual tools used in the pilot study unit.

The everyday communication between the students was organized through a blog web site. The blogging service used was Blogger. Each student and group was supposed to discuss their teaching assignment and share the steps taken during the acquiring of knowledge in the blog. The students did not insert their thoughts in a form of a blog thread, but instead of that as a comment to the lead tutor's starting post. Thus, as a result a continuous comment chain was formed. The students did not start new threads of discussion, they were commenting to each other's comments, only. We three tutors followed the blog discussions and took action by guiding the students in the blog. Our inserts in the blog were in a form of blog comment, too.

During the implementation of our pilot study unit there were all together 765 blog comments made by our three groups including our 21 students and 3 tutors. Group one made 293 comments, group two 250 comments and group three 231 comments. In average each student made over 7 comments every cycle. Because our cycle rhythm was 3 weeks, each student wrote over two comments per week. In addition to the comment inserts the students were visiting the site to benchmark what other students had written. There were 5066 visits to the blog site, out of which group one made 1491 visits, group two 1525 visits and group three 1076 visits.

During each cycle the three groups of students wrote a group paper solving the teaching assignment prepared in the tutorials. The forum for this essay was arranged in a form of a wiki. The wiki we used in our pilot study unit was Wetpaint wiki for Education. Since there were five cycles in the pilot study unit, the three student groups wrote five wiki group essays, each. By discussing in the blog and writing in the wiki, e.g. using the web 2.0 tools, the students were acquiring collective knowledge. The actual construction of knowledge took place in the ending tutorials of each cycle, although the students co-created meanings and knowledge during the 6th phase as well when exchanging thoughts in the blog and producing the wiki essay.

One of cycles during the pilot study unit was implemented completely virtually. The students participated in the tutorials from their homes or offices through the synchronous web video conferencing service iLinc, a tool used regularly at RUAS for such purposes. As a supporting tool to gather and present the ideas of the student brainstorming in the starting tutorials and the concept map of the constructing of knowledge in the ending tutorials we used CMapTools computer software.

From teachers' viewpoint, PBL clearly changes the role of the teacher. Instead of traditional teaching in front of the class, the teacher becomes a tutor who guides and coaches the students' learning processes. Interestingly, the students' expectations have also shifted from a knowledgeable on one's field and professionally competent teacher to a more socially and emotionally oriented, sufficiently available and reachable person who is an expert of learning processes. For instance, the students were using the virtual environments mainly during the evenings and weekends when they also expected the teachers' help to be near. Also, the use of technology brought its own challenges to both teachers and students.

As Duncan, Lyons and Al-Nakeeb (2007) summarise, PBL is not barrier-free to tutors who have got used to a more teacher-centred approach in their work. PBL places the student in the very centre of learning, which may produce frustration and fear among the teachers. However, in our pilot study unit we also encountered that the students were from time to time, if not annoyed, but surprised about the amount of work they had to carry for meeting their personal and collective learning objectives. Some of

the students may have pondered the role of the teacher in this process. Also, some students seemed to miss traditional teacher-driven lectures and contact sessions. To us tutors, the trickiest part was to learn to keep our mouths shut and lips sealed to give room for student intervention, effort and experiences. In terms of guidance and counselling of learning, it can be said that the tutors have to put enough of effort and time to personal and collective counselling.

The assessment of the pilot

Traditional assessment is based on measurement and control. This creates a certain test-culture, where the emphasis is in the fact, whether the students are aware of the subject at hand, and the learning is weighed in terms of correctness of the answers. Whereas this traditional evaluation focuses on cognitive issues, PBL assessment incorporates also creative problem-solving, social and emotional angles into the process (see Rinck de Boer & Otting, 2011). Also, the assessment is done from the viewpoints of skills for learning to learn, and communication and collaboration skills. (Poikela, E. & Räikköläinen, 2006.) Since the PBL emphasises the role of the tutor as a guide of the student's learning, it also highlights the importance of reflection, feedback and co-assessment. This produces a more participative assessment-culture. However, the outputs of learning assessment are still important because the students want to obtain information on their learning outputs and level of expertise. (Poikela E., 2006.)

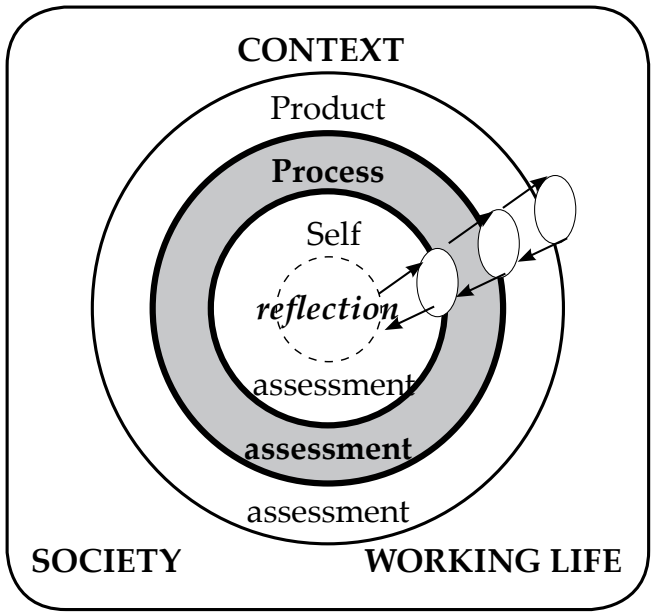

Figure 2. The mirrors of the assessment process (Poikela, E. &Poikela, S., 2005)

The assessment design in our pilot study unit was directed by the following theoretical point of view: learning and knowledge production is not essential to it, what happens to the individual, team or organization level but what happens between them. In the pilot, we used Esa Poikela's evaluation design model, assessment zones and mirrors. In this model he identifies an analogical relationship between judgmental assessment and contextual analysis. (Poikela, E. & Poikela, S., 2005).

In the assessment of the students we used both qualitative and quantitative tools. Our main qualitative assessment was the tutor feedback we gave after each tutorial. This feedback was given orally and publicly to all students. During the guiding phase of the blog and wiki writing further feedback was given to individual students. This feedback was mainly focusing on the process of each student's activities within the group's work. Simultaneously we used the students own assessments in the form of learning reports of the students were supposed to write after each cycle. The tutors studied the learning reports from the students and used that feedback when giving individual qualitative guidance to the students.

The quantitative assessment of the students took place in the form of tutor assessment of the student engagement in the tutorials and the blog writing, on one hand, and their output in the collective wiki writing, on the other hand. The final grading of the students took into account the student groups' wiki writings quality and competence shown in it, too.

The evaluation of the pilot study unit

For the purposes of the evaluation and further development of PBL at RUAS we gathered feedback on the pilot study unit from the students. We used versatile quantitative and qualitative methods. As our first qualitative feedback gathering method we used the "Roses and thorns" -method, which included that the students were put into small groups to discuss and list a few positive things about the study unit and a few negative things. Another qualitative feedback method used was the "Empathize method" based on positive and negative frame stories. The students were divided into two groups and the first group was to write a short essay on "why the pilot study unit was so successful" and the second group was to write a short essay on "why the pilot study unit was so unsuccessful". The qualitative student feedback was analysed using content analysis. Quantitative feedback was gathered using the RUAS web based standard student feedback form on study unit. The data was analyzed in the RUAS feedback system, and it was presented in the form of frequencies and averages.

Results and discussion

Our results show that the target group, adult Master's students of engineering, adopted a new pedagogical method without hesitation. The students considered the PBL method itself as a positive experience. In particular, the tutorials were considered as fertile group discussions and workshops where the students learned new skills. The students had experienced the tutors' role and support as irreplaceable for their learning process.

The multiple learning environments, particularly virtual learning environment, were highly applicable in adult students' distance learning used in our pilot study. Our evidence supports the proposition that the use of multiple PBL-learning environments enhances deeper learning. Furthermore, our study shows that virtual learning environment supports the construction of knowledge. We can state that the Problem-based Learning can be used in adult distance learning of knowledge management and strategic human relations management.

The issues that the students considered worth developing for the future implementation related to learning environments, tutorial practices, tutor's participation and assessment. Namely, the students would have probably experienced the use of technology and virtual environments even more positively if the instructions to different tools, programmes, applications and environments had been provided in more detail and even earlier. Also, in-between the three groups led by three tutors the students had identified some differing tutorial practices and principles. This may yield to some suspicion and uncertainty among the students. After all, the tutors should be able to create trustworthy surroundings for the students' personal and collective learning processes. Unfortunately one group suffered to some extent for variation of the tutor. Due to schedule problems and overlapping work appointments there were two tutors exchanging tutorial "shifts" in two or three cycles. However, the two remaining groups had only one tutor throughout the five cycles of the study unit. The students gave credit for that whereas the students of the third group mentioned this tutor dilemma as a drawback.

Also, assessment was mentioned by the students as an area to be re-evaluated. In the PBL-based study units to come, the students should have an even more active role in the overall assessment. Additionally, the assessment criteria should be thoroughly clarified to the students, if not even co-created together with them. It must be admitted here that the effort we put in the assessment was at least moderate, but the amount of work surprised us tutors. After the autumn semester had started, we faced difficulties in finding a common time for assessment planning meetings. Therefore we could not use as much time for building the assessment criteria as we would have wanted to. On the other hand, PBL requires flexibility and tolerance for uncertainty,

and the fact that we were not able to totally "lock" the criteria and describe its wordings was not necessarily a drawback. At some point the students may have had slight unawareness about the criteria, which is of course unfortunate. However, the actual process, output and outcome assessment was done in appropriate way, and enough of resources were put in that work.

According to our gathered feedback (feedforward) the students learned a lot about, with and due to PBL method. The students had experiences personal growth in skills of information search (e.g. the use of library resources and e-databases), group work practices ("This helps me in my workplace meetings") and learning in terms of learning to learn as well as professional subject areas. In particular, according to the students, they had gained further expertise in deep learning that refers to the ability to restore and remember the learned knowledge for a long period of time. In this sense, the adult students' working life connection helps in this, since they can immediately reflect their cognitive learning on the concrete work practices and their development. Thus, knowledge turns into practical routines. The students valued the PBL-method for its knowledge abstraction process. For the Master's students it is very important that they learn to organize, internalize, conceptualize and socialize knowledge. As Coombs and Elden (2004) put it, employers are striving for employees who are competent in teamwork, leadership, communication and the ability to critically reflect one's personal behaviour and the surroundings that is vital in balancing with unstructured, nonlinear problems.

The empathize-method produced concrete, pragmatic ideas how to develop the study unit and the PBL process even further. Some of the texts included clear tips ('do this', 'keep this', 'abandon that'), whereas some of the issues dealt with more abstract principles relating to the PBL planning and tutor and tutorial practices. Also, some students talked to a great extent about the PBL-method itself. The students also showed high level competencies in evaluating and critically reflecting their own learning, learning outcomes and motivation.

As a whole, the empathize method addresses the importance of clear feedback (to be turned into feed forward for the students wiki essay products; do this, don't do this, change that - in addition to more empowering guiding through asking questions). Also, the students value and have an accurate eye for the tutors' collaborative planning and implementation practices. The PBL method was most suitable for the adult students' management learning for its participatory and self-reflective nature. The students managerial and collective working life skills were enhanced in the study unit to a great extent, but it called for active participation and commitment from both the tutors and the students. Also, it can be stated that the students should experience that their own personal and collective group expertise and the requirements and the workload of the study unit are levelled. This promotes motivation and helps to sidestep frustration.

In the specific empathize-method based content analysis we found that the key factors through which the PBL process either succeeds or fails include three interconnected areas that come together in planning, executing and evaluating the competence and problem-based learning. Firstly, tutor's role and the tutors' mutual work practices are in the very core of the PBL method. This underlines the importance of sufficient time and effort placed in careful planning and execution of the study unit. In particular, evaluation should be considered with a detailed accuracy and unconditional commitment. Secondly, our case emphasises the importance of the group dynamics. The peer-to-peer feedback and approval within the tutorial group community is a solid part of the students' reflective learning experience. Interestingly, the tutorial group is probably the key unit in personal and collective learning, although also the students' personal data acquisition is of great importance in learning. However, the blog assists them in remaining in close contact with each other also during the tutorial meetings. The tutors should help the tutorial group to merge together rather quickly to make it support the learning outcomes.

The third success factor emphasises the significance of principles in planning and executing the PBL study unit. However, it became clear that instead of running the process with strict general PBL guidelines they had to be modified to meet the needs of the specific study unit. In particular, the specific nature produced by the setting combining the adult education, the students' working while studying procedure; the substance areas of engineering and human resources management; and the needs of a professional (instead of purely scientific) Master's Degree Programme called for contextualisation (see Sherwood, 2004) and rethinking of the PBL process.

The quantitative survey data showed us the fact that the students consider that PBL has promoted their learning of the substance area. They also valued the delivery of implementation plan that helped them to gain an overview of the topic at hand, the schedule and the criteria of evaluation. The learning outcomes were met according to the survey. The workload of the study unit was considered reasonable, although we are talking about adult students, who also (or mainly) work, here. The students rated the tutoring and personal consultation high while also giving credit for their own personal and collective efforts in meeting the learning objectives.

Conclusions and implications

In this paper we have presented experiences from the Master's students and tutors involved in a PBL-based pilot study unit dealing with human resources management. In particular, we have covered the challenges and possibilities of practising PBL in adult education context, discussed advantages and disadvantages of diverse use of technology, and analysed the outcomes and concrete feedback on participatory co-

learning. This study has been conducted in one School of Technology that belongs to a University of Applied Sciences. Despite the strong case study oriented nature, most of the results are most likely applicable in a wider context for they connect interestingly to the current PBL debate, and also contribute to the pedagogical paradigm shift in management education.

As said, we have implemented the study unit together with the adult students, already active in working life, working simultaneously while studying in our graduate degree programme. Our conclusion of the pilot study unit is that PBL produces learning among adults as long as the attention is paid to learning in holistic and careful planning. Furthermore, virtual learning environments are particularly well suited not only for the PBL procedure but in general for distance learning of adults and their working life connections. We can also state based on our analysis that the learning process guidance and counselling is the responsibility of a tutor, but students should be self-motivated and able to provide peer-to-peer support. However, tutors have to put enough of effort in their common policies and collaborative sharing of good practices within the guidance of the learning process.

To close, it is necessary to reserve enough of time for the learning process and particularly for the comprehensive assessment of the design. This study also underlines the fact that PBL procedure and pedagogy does not diminish the overall tutor resources of teaching, but *re-allocates* them from teacher-centred contact lecturing to planning; guidance in and in-between tutorials; and increasingly in process as well as output and outcome evaluation. The role of careful planning of the study unit, continuous reflection by the tutors about the pros and cons of the learning cycles, and transparent evaluation cannot be over-emphasised in implementing PBL pedagogy. After all, constructive and committed feedback (and feedforward within the learning cycles) is of high importance in the students' learning experiences.

References

Coombs, G. & Elden, M. (2004), Introduction to the Special Issue: Problem-Based Learning as Social Inquiry—PBL and Management. *Journal of Management Education*, 28(5), 523-535.

Duncan, M., Lyons, M. & Al-Nakeeb, Y. (2007), 'You have to do it rather than being in a class and just listening.' The impact of problem-based learning on the student experience in sports and exercise biomechanics. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 6(1), 71-80.

O'Reilly, T. (2012), Web 2.0 and the Emergent Internet Operating System. http://tim.oreilly.com/p2p/index.csp

Poikela, E. (2006), Ongelmaperustainen pedagogiikka-näkökulma projektioppimiseen. Julkaisussa: Ruohonen, S. & Mäkelä-Marttinen, L. (toim.) Luovuuden lumo-kokemuksia projektioppimisesta.Kymenlaakson ammattikorkeakoulu. WSBookwell, 23-38.

Poikela, E. & Poikela, S. (2005), The Strategic Points of Problem-Based Learning – Organising Curricula and Assessment. In E. Poikela & S. Poikela (eds.) PBL in Context – Bridging Work and Education. Tampere University Press. 7-22.

Poikela, E. & Poikela, S. (2006), Problem-based curricula – theory, development and design. In E. Poikela & A.R. Nummenmaa (eds.) Understanding Problem-Based Learning. Tampere: Tampere University Press, 71-90.

Poikela, E. & Räikköläinen, M. (2006),"Intelligent accountability"-kontekstiperustaisen arvoinnin lähtökohtia. Ammattikasvatuksen aikakauskirja, 8-18.

Rinck de Boer, M. & Otting, H. (2011), Student's voice in problem-based learning: personal experiences, thoughts and feelings. Journal of hospitality and tourism education, 23(2), 30-40.

Savin-Baden, M. (2007), A Practical Guide to problem-based learning online. New York: Routledge.

Sherwood, A. L. (2004), Problem-Based Learning in Management Education: A Framework for Designing Context *Journal of Management Education*, 28(5), 536-557.

Wheeler, S. (2006), Learner support needs in online problem-based learning. The Quarterly Review of Distance Education, 7 (2), 175-184.

Zwaal, W. & Otting, H. (2007), Hospitality management students' conceptions of education. *Tourism and Hospitality Research*, 7(3/4), 256-268.

Assessing outcomes of problem-based learning in economics

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Introduction

Although lectures with traditional testing continue to dominate, innovative pedagogies have been slowly entering the economics discipline in higher education (Watts & Becker, 2008, see also Becker & Watts, 1998; and Becker, Watts & Becker, 2006). The disciplinary lens predisposes economic education researchers to consider, as Blinder (1991, 251) suggests, whether the benefits of deviating from the traditional lecture with examinations justify the costs of innovation. Of course evaluations of the effectiveness of a new teaching method are good scholarship, and all of the published papers about problem-based learning in economics include an empirical section devoted to working out whether students benefit. Unfortunately, there are few evaluations of problem-based learning that measure variables associated with the defining features of problem-based learning in economics.

Engel (1997, 19) outlines the aims commonly attributed to problem-based learning: to foster competency in adapting to change, making reasoned decisions in unfamiliar situations, creative and critical thinking, approaching issues more holistically, behaving empathetically towards others, collaborating effectively and continuous self-evaluation; and to foster effective adult learning, defined as active learning through questioning, contextualized learning that draws on a number of disciplines, learning in which progressively richer complexity and challenge is integrated to what is already known,

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and learning for understanding using frequent feedback and practice (as distinct from memorizing for a one-shot examination). These qualitative and affective aims should be the target outcomes in research about a problem-based instructional approach.

The predominant empirical approach to problem-based learning in economics is a comparison experiment in which the performance on a multiple-choice test of students who experience the instructional innovation is compared to that of a control group. These fixed response tests are not designed to inform on Engel's (1997) aims of problem-based learning: for example, learning for understanding looks exactly like rote memorization in a multiple-choice examination. Furthermore, a number of skills proficiencies that problem-based learning is thought to foster are better assessed in other ways (for example Kustra, 2009; Painvin et al., 1979; Powles et al., 1981). It is fortunate that there are other instruments that can discern some of the aims of problem-based learning.

The first task is to define problem-based learning. It is well known that people carry different models or varieties in their minds (Woods, 2012a & b; Savin-Baden, 2012). While collaboration and complexity are surely important features, I take the degree of autonomy being afforded to students as the defining aspect of problem-based learning for this paper because of its omission from much of the literature reviewed here. Problem-based learning can be mapped as a member of the class of self-directed learning pedagogies which involve relatively more learner autonomy than other pedagogic approaches available in higher education (Roy, Kustra & Borin, 2003). In particular, the second-year survey of international economics that I teach using a variant of the familiar McMaster model (Neufeld & Barrows, 1974) has a high degree of student autonomy in the collaborative group work and problem refinement/research/reporting aspects, but only takes small steps in giving students autonomy on metacognitive self-assessment.

Economics is particularly well suited to problem-based learning, and it is valuable that the discipline is adding exercises in self-directed learning at the margin to its predominantly traditional pedagogical approach. However, a number of concepts and definitions used in the economics education literature do not serve the discipline well in contextualizing problem-based learning, either as an approach to a set of learning outcomes or as a pedagogy to evaluate. I first use the broader scholarly literature to characterize the competencies that are associated with problem-based learning as a particular type of self-directed learning.

The prominence in economics education of references to teaching students to think like economists suggests that the discipline is concerned with fostering learning for understanding (Siegfried et al., 1991; Santos & Lavin, 2004; Hansen, 1986 and 2001). Again, a bridge to the broader scholarship on teaching and learning in higher education may help. With that bridge to the concept of learning approach in place, I

present the empirical results of my own course, using survey instruments developed at Lancaster University in the early 1980s (Entwistle & Ramsden, 1983). These tools make it possible to provide part of the picture about the effectiveness of problem-based learning with regard to a student's orientation to learning and the environment in which that learning is fostered, which might be useful to any discipline that places priority on engaging students more authentically in critical thinking and effective forms of evidence-based argument. The paper concludes with brief observations about where problem-based learning might fit in the economics curriculum.

What is problem-based learning?

Definitions of instructional practice matter in the scholarship of teaching and learning because students' learning outcomes can depend on the component activities, supports and challenges that comprise the course (Biggs, 1996). It would be convenient if the name of any instructional technology communicated a common understanding of the expected student outcomes and experiences. This is not the case in problem-based learning, where the term is used to label a diversity of modifications of the model (Woods, 2012b; Savin-Baden, 2012). In the absence of common terminology, clarity and specificity about what elements are present in any particular course design is essential if empirical or discursive comparisons of problem-based instructional technologies are to be tractable.

Pioneered at McMaster University in the late 1960s for use in the new medical program (Barrows, 1996, 4), authentic problem-based learning is characterized by a high degree of student control for the content and the processes of learning (Neufeld & Barrows, 1974; Woods, 1994; Woods, 2012b; Rangachari, 1996). It is a member of the broader class of self-directed learning educational technologies in which the student determines what to learn and how to go about learning it, in response to a theme, project, scenario, case or trigger that serves to initiate the curiosity that drives the student in their learning (Roy, Kustra & Borin, 2003). There are a number of choices about the course that further define the instructional approach, including who has responsibility for the assessment (self, peer, instructor or a combination), the degree of instructor support for providing the content (none in inquiry, complete in case-based learning), and the number of students working together (individuals, small group, large group). Finally, the questions that carry self-directed learning through to its conclusion may or may not have an actual solution.

Economics is particularly well suited to problem-based learning: "complex, messy issues can never really be taught in a didactic fashion, [so] it is important that students be involved more actively in their own learning" (Rangachari, 2000, 49). In the McMaster model which informed my course, the instructor provides students with a problem or trigger amenable to any sequence of questioning and critical thinking

(Neufeld & Barrows, 1974; Barrows, 1996). Groups of students work collaboratively to determine what they know already, what they need to know to understand the issues raised in the problem and how they will go about learning what they need to know. Students develop and use their individual and group resourcefulness in learning and capacity for reflection to decide what they believe about an issue and what evidence supports why they believe it, making judgments about how best to represent the evidence of their learning, perhaps with some instructor guidance. Finally, students engage in a separate self-assessment or reflection on their effectiveness in learning at specific times in the course (for example, at the end of every group meeting; at the end of an assessment; at the end of the course). This cycle repeats a number of times in the course, complemented by individual and/or group assessments that utilize the same proficiencies over a shorter time frame (see for example Kustra, 2009; Painvin et al., 1979; Powles et al., 1981).

The most common question I hear from colleagues concerns whether the effort of this approach is worthwhile. The question assumes that the traditional lecture course with traditional testing, used predominantly in economics (Shauer, Watts & Becker, 2008; Watts & Becker, 2008; Bloemhof, 2012), is equally effective in meeting the instructional objectives. But lecturing is only the appropriate for comparison if the main instructional objective is information transmission in circumstances where the learning goals of the lecturer and the student are similar (Bligh, 2000). This is surely true in an academic research seminar or a public lecture, but it may not be true in a second-year survey when the majority of students do not have much prior knowledge about international economics or policy. The assessments in a traditional lecture course may communicate to students that the discipline holds uncontroversial, knowable, single right answers to the ideas presented, despite instructors' efforts to model questioning and contextual richness. In other words, the predominantly lecture-based test-assessed pedagogy may obscure the complex and relevant, dynamic and personal nature of economic events.

In contrast, problem-based learning is designed to require curiosity, critical thinking, engagement and self-reflection in order for the student to succeed in the course. The sequencing and interaction with the material is more closely aligned with how learning happens outside of a course setting (Neufeld & Barrows, 1974, 1043), fostering interest and training students to be confident and autonomous life-long learners. Students have the opportunity to explore the messiness of economic issues and develop their proficiency in economic ways of argument and forms of evidence. The course contributes to statistically significant improvements in motivation and retention, as well as confidence in team work and problem solving (Woods, 2012a; Hattie, 2009; Albanese & Mitchell, 1993; Vernon & Blake, 1993). According to Woods (2011), problem-based learning fosters "committed relativism," the most integrated level of intellectual development (Perry, 1970), in which students understand that knowledge is contextual and know why they believe what they believe, and are also prepared to adjust that belief in

the face of credible evidence. This could explain Regehr and Norman's (1996) evidence that problem-based learning may enhance proficiency with transferring knowledge to new situations, a vital but challenging goal for instructors to foster.

I can think of no better reason for using problem-based learning in a second-year economics course than the dearth of evidence that these proficiencies are explicitly fostered or necessary for success in the instructional approach that dominates in the discipline. It is well-known that students get better at the lecture/test format of courses as they progress in the academy (Watkins & Hattie, 1981). Therefore, the earlier in their program of study that students are offered some self-directed learning experiences, the better in order to leverage the benefits from fostering curiosity and critical thinking in an economic context.

I adapted the McMaster model of problem-based learning to a second-year survey course in order to use the complexity of international economic issues to teach a particular set of self-direction competencies. The class enrolls up to 120 students, so several groups of six to nine students were assigned randomly and facilitated by non-expert tutors. While primary responsibility for group discussion, group process and norms rested with the students themselves, each tutor is trained to support their group's learning process and pose questions intended to help students develop their own productive research perspectives (Hmelo-Silver & Barrows, 2006; Rangachari, 1996). One of the two weekly 90-minute class meetings is a group meeting in which students identify, refine and debrief learning goals inspired by the problems; the other is used for interactive whole-class activities or mini-lectures used judiciously to make the cognitive demands on students more manageable. Students develop most of the content themselves with no prescribed textbook or reading (Rangachari, 2000, 50), although they are encouraged to select a textbook that they like to support their learning. Learning objectives for each of the four problems and two problem-based assessments are not shared with students until after they are finished with it; all problems are vetted by volunteer peer tutors not involved with facilitation, to ensure that they engage the desired learning objectives. The major assessment is an individual triple jump over two classes (Kustra, 2009) which is run once for formative feedback at midterm, and once summatively at the end of the course. Significant formative feedback on graded deliverables counteracts potential ambiguity in expectations. Homework problems timed to support the economic theoretic ideas appropriate for the problems may be selected randomly to make up the final examination[2]. Finally, reflection and self-assessment are used regularly (at the end of every group meeting, in both triple jumps, and in a final course reflection on learning process submitted for evaluation).

[2] Students in this environment expect a final examination. The certainty of the range of content on the final balances the uncertainty load across the assessments. Students do not receive the answers to the homework questions during the term. The image of small teams of students working collaboratively to revise and defend answers to these candidate questions for the final examination is, to my mind, quite congruent with the precepts of self-directed learning.

Table 1: International Economics: Chickering and Gamsen's (1987) Seven Principles for Good Practice

Course Element	Description	Principle (Chickering & Gamsen, 1987)
Weekly group meeting	facilitated by professor and peer tutors in separate seminar rooms	Encourages student-faculty contact
Self-directed group process in weekly group meeting	Learning goals are set, refined and debriefed in groups of 6 to 9 students; Students are responsible for the discussion and for setting group norms, building cooperation and reciprocity in establishing learning goals and tasks (facilitator is not responsible for content) Students organically coordinated to prepare for final examination	Encourages cooperation among students
Large-group activities	Examples: condensed dry run of problem cycle (Woods, 1994:1-1); information literacy assignment using research resources at the library; experiential trade simulation contribute to normalizing active learning in small and large group meetings	Encourages active learning
Problem research summaries	Returned in subsequent group meeting, contributing to continuous improvement	Gives prompts feedback
Mini-lectures, activities and homework questions	Selected and timed to support work on the current problem; no extraneous activities	Emphasizes time on task
Expectations	Large-group activities to develop judgment and proficiency with integrity issues; grading rubric published in syllabus; 1 of 4 summaries and 1 of 2 major assessments graded formatively to set expectations	Communicates high expectations
Metacognitive exercises	Students reflect on their learning in each group meeting, each major assessment, and final written reflection	Respects diverse talents and ways of learning
Collaborative learning	Students research the issues of interest to them in the problem, practicing their research skills and developing own resourcefulness	

One way to analyze my course is to link its design elements to the seven principles for good practice in undergraduate education developed by Chickering and Gamsen (1987). The key course elements are the weekly group meeting and the assessments. Table 1 links the course elements with the corresponding principle for good practice. The tutor chooses the problems and has majority control of the graded assessment with some student input, and all other aspects of the learning are owned by the student (Woods, 2012b).

Problem-based or self-directed learning in economics?

There are a number of descriptions of innovative instructional approaches in economics contexts that use the term problem-based learning. However, based on their descriptions of the elements of the course, none are close variants of Neufeld and Barrows (1974) authentic problem-based learning. Rather than autonomous learners controlling the learning process with the instructor as a facilitator rather than a knowledge provider (Barrows, 1996; Woods, 1994), instructors appear to be setting learning goals and providing explicit direction for how to meet them. Goodman (2010) describes a learning environment wherein students are given learning objectives, guiding questions and steps for solutions to the problem, a method that Woods (2012b) has called problem-based synthesis. The high-school economics setting in Maxwell, Mergendoller and Bellisimo (2005) and Mergendoller, Maxwell and Bellisimo (2006) both appear to have the instructors provide content when asked, which is more consistent with group-based self-paced instruction. Finally, Smith and Ravitz (2008) describe a collaborative learning curriculum where students receive information that will help them understand and "solve" the problem in a scenario.

These contributions certainly move in the direction of more student-centered pedagogies without embracing the autonomous learning that I have argued is needed for problem-based. None of Goodman (2010), Maxwell, Mergendoller and Bellisimo (2005), Mergendoller, Maxwell and Bellisimo (2006), or Smith and Ravitz (2008) discuss how they prepare students for the affective elements of a self-direction experience (as recommended in Woods, 1994 & 2006, and Tan, 2004). The problems posed have target solutions, in contrast to open-ended situations presented in problem-based learning (Barrows, 1996; Savin-Baden & Major, 2004). While there is clearly the sort of social learning process that students find highly valuable to their learning (Brookfield, 2012, 55), there is apparently no use of metacognitive activities or assessments, which are a hallmark of problem-based learning (Woods, 1994).

Despite this, it is useful to explore the strengths of these innovative learning opportunities, without implicitly assuming that information transmission is the most important learning outcome. Unfortunately, none of the studies mentioned above evaluate more than knowledge gains or differential information assimilation using a standardized test. Maxwell et al. (2005, 316) explore "differential knowledge and learning" and Smith and Ravitz (2008, 22) look at "student understanding." Both papers use students' change score on a pre-and post-test using the 30-item Test of Understanding in College Economics[3] (Walstad, Watts & Rebeck, 2007). Without careful design, however, multiple-choice testing cannot correctly differentiate between

[3] Another instrument, the 35-item Tests of Economics Comprehension (Lumsden, Attiyeh and Scott 1980), is also available for assessing general economic knowledge.

knowledge earned through study and a good guess (Wiggins, 1996). Granting that a well-designed multiple-choice test can be useful to mark differential gains in knowledge, it is the wrong tool discerning the process skills and affective objectives that problem-based learning fosters.

Investigators should wonder about learning outcomes beyond the cognitive domain when assessing the performance of problem-based learning, because although evidence from medical school multiple-choice examinations is mixed (Hattie, 2009; Albanese & Mitchell, 1993; Vernon & Blake, 1993), evidence from beyond health sciences indicates knowledge acquisition that is no worse than that found in traditional lecture-based courses (Woods, 2012a). A number of other indicators of the effectiveness of problem-based learning could be assessed: problem-solving skills, critical thinking, student satisfaction, student motivation, student propensity to take more courses in the field, the complexity of questions that students ask during class, the ability to recall material after the course is over, facility with applying the course learning to new situations, and so on. The choice of research instrument should depend on the learning outcomes being sought, rather than parsimony or the technical proficiencies of the seeker. Fortunately there are other well-understood instruments that can detect the claimed beneficial effects.

Evidence of deep approaches to learning in economics

A number of the learning outcomes attributed above to problem-based learning are observable over time and/or using qualitative methods. Quasi-quantitative scales, developed by Entwistle and Ramsden (1983) in response to the seminal work on approaches to learning by Marton and Säljö (1976), are available for measuring a student's intention to learn for meaning (to take a deep approach to their learning) within a single course cycle. This is convenient for studying learning in individual economics course settings.

In response to mistaken use of the deep and surface learning paradigm, Entwistle (1997) helpfully characterizes understanding and constructing meaning as reflective of a desire to have an autonomous understanding that incorporates prior experiences and understanding. Therefore, a deep approach to one's learning is "[a situation] in which a person tries to understand and construct meaning" and a surface approach is "[one in which the person] does not see past the text to the sense and meaning of the passage… [achieved by] looking for patterns and underlying principles, checking evidence and relating it to conclusions, and examining logic and argument cautiously and critically" (Entwistle, 1997, 214). Unfortunately in the economics education literature the misconception persists that deep learning can be measured by "student performance on the deep learning and surface learning portions of [a traditional multiple

choice] exam" (Santos & Lavin, 2004, 149), which confuses the curriculum with the learner's intention. Citing this work perpetuates the misunderstanding, ironically taking a surface approach to learning about students' approaches to learning.

A more subtle model of learning has been crafted over thirty years (Entwistle, 2010). It encompasses concepts clarified by Entwistle (1987, especially chapter 3 and Table 3.1 on page 60) and repeated here: students who adopt a deep approach to their studies have an intention to search for meaning in the material they are learning. By contrast, students adopting a surface approach have no such intention; they are merely trying to memorize the material so that they can complete the tasks that are set for them in a course. The student taking a deep approach is intrinsically motivated by a desire to understand for its own sake. Such individuals interact vigorously with the material as they try to integrate new ideas with what they already know or to relate it to their own experience; they explore the ideas with a critical eye and work at understanding and evaluating the reasons for the ideas with which they are presented. The student taking a surface approach is extrinsically motivated by fear of failure. There is no attempt to build up a narrative about the material being studied by a student adopting a surface approach, but instead discrete ideas, concepts or facts are learned without exploring how they hang together. In a surface approach the goal is to complete the externally-imposed learning tasks without expending effort on connecting the material to previous knowledge or personal experience, or developing a sense of the purpose or strategies for completing the task.

Biggs' (1996) argument for constructive alignment reflects the strategic nature of these orientations or approaches to learning. If a surface approach is adequate to meet the instructor's expectations, even a student with a predisposition to learning for meaning or understanding will adopt a surface learning approach, while simultaneously taking a deep approach to learning in another course in the same academic session! This is one of the reasons that problem-based learning is a valuable complement to more traditional pedagogies. The opportunity to explore complex issues and the freedom to exercise their competencies may initially puzzle students, or even create anxiety at the change from passive to active learning. Gradually, however, pursuing learning objectives of their own choosing and following their curiosity in a learning environment supported with formative feedback becomes more comfortable. Without congruence between the learning objectives, the assessments, and the teaching approach, the effectiveness of problem-based learning can be diverted by incongruent assessments (Delva et al., 2000). An instructor can only influence approach to learning indirectly, by creating an environment where learning for understanding is valued and rewarded using assessments which are congruent with the course objectives and teaching method. When students perceive that they are expected to get their hands muddy in the learning sandbox, they may find that activity liberating and intrinsically motivating, which can induce them to adopt a deep approach for this task or this course.

The appropriate instrument for differentiating deep and surface approaches to learning is the Approaches to Studying Inventory, from the family of questionnaires developed by researchers at the University of Lancaster in the late 1970s and early 1980s (Entwistle, 1997; Perry, 1983; Woods, 2011: Appendices A and B). A second Lancaster instrument, the Course Perceptions Questionnaire, provides data about factors in the learning environment that foster a competency-based curriculum and support a deep-learning approach in students. Questions focus on environmental characteristics or features which Entwistle and Ramsden (1983) found to be most influential to both learning for understanding and rote, superficial learning. The learning environment includes the teaching approach and assessments in the evolving model of learning described by Entwistle (1987, 106; 2010, 37).

I assign the Approaches to Studying Inventory and the Course Perceptions Questionnaire in my problem-based international economics course as a trigger for students to use in their formal reflection[4]. The class average response to the Approaches to Studying Inventory administered at the end of the course is presented in Table 2.

Table 2: Average Response to Approaches to Studying Inventory (ASI)

	Strategic	Surface	Deep	ASI SCORE
International Economics Univ. of Waterloo 2012 (n=53)	16.3	15.4	16.4	17
Range for Economics* (n=450)	9.5 to 10.8	12.8 to 15	8.4 to 12.1	to 7.9

ASI Score = Strategic + Deep – Surface. * Source: Entwistle and Ramsden 1983 Table A6, p. 242.

The strategic, surface and deep subscales range from zero to 24, and the overall ASI score has a possible range from -24 to 48. Students appear to have been strongly oriented towards learning for understanding, with a deep score substantially higher than the economics sample in Entwistle and Ramsden's (1983) original research from the late 1970s. This is perhaps unsurprising because problem-based learning requires a search for understanding in identifying and prioritizing learning goals and in working collaboratively to fulfill those goals. The range reported by Entwistle and Ramsden is far more amenable to success through rote memorization.

Table 3 reports class average Course Perception Questionnaire responses and some metrics derived from them. The Course Perception score ranges between -24 and 72,

[4] The collection and use of student data for this paper were reviewed and received ethics clearance (Office of Research Ethics 17927, 2012, University of Waterloo).

with higher scores being more desirable than lower scores; similarly, scores closer to the maximum of 24 are more desirable for the student-centeredness measure. For control-centeredness, however, scores at the low end of the range (-2 to 22) are more desirable. Desirable values of the ratio of these numbers are greater than one, indicating that the control-centeredness score is lower than the student-centeredness score.

Table 3: Average Response to Course Perceptions Questionnaire (CPQ)

	Good Teaching	Openness to Students	Freedom in Learning	Clear Goals	Vocational Relevance	Social Climate	Work Load	Formal Teaching Methods
International Economics, UWaterloo 2012 (n = 53)	9.3	9.9	8.6	5.6	6.5	6.0	5.8	4.5
Range for Economics* (n=450)	8.0 to 14.1	6.2 to 11.8	7.4 to 12.6	8.4 to 12.7	6.2 to 9.0	7.8 to 12.0	5.6 to 13.5	5.5 to 7.8

	Course Perceptions	Control-Centeredness	Student-Centeredness	Ratio: sc/cc
International Economics (n = 53)	36	7.3	18	3.5

* Source: Entwistle and Ramsden 1983 Table A6, p. 242.

Course Perceptions Score = total of (good teaching; openness to students; freedom in learning; clarity in goals; vocational relevance; social climate) minus (workload; formal teaching methods)
Control-centered Score = 10 + workload – freedom in learning
Student-centered Score = good teaching + freedom **s/c** = ratio of Student-centered to Control-centered score.

The results suggest that the classroom environment for international economics fostered a deep approach to learning, through creating a student-centered environment. The formal teaching methods score and the clear goals score are low, but again this might be expected because students of problem-based learning are asked to define and justify learning goals, which introduces some ambiguity.

The Lancaster approaches instruments are useful clues to the learning process that is going on in the course as a necessary first step in assessing the qualitative aspects of learning that matter most in a problem-based context (Coles, 1985). Together with other qualitative information, the researcher can build a picture of the ways in which learning is experienced. Only then can one know if problem-based learning is providing useful proficiencies development for students of economics.

Conclusions

Self-directed learning is a valuable complement to the traditional pedagogies that dominate in economics. Within that class of instructional technologies, problem-based learning gives students an opportunity to decide what to learn, how to go about learning it, and which economic forms of evidence and argument are most valuable in presenting their beliefs. Norman and Schmidt's (1990) warning against an all-problem-based learning curriculum may be appropriate in the economics discipline, but our students can certainly benefit at the margin from the opportunities it affords to foster affective and ethical capabilities to complement cognitive curriculum goals. Reframing the methods used in health sciences clinical training to economics contexts requires some care in order to create environments where a deep approach to learning is chosen by most students, because the literature reviewed here suggests a strong tendency to curtail the potential for autonomy by telling students exactly what they should do in order to analyze a problem. Such an approach is not authentic problem-based learning, but as active learning it is certainly a welcome departure from traditional lecture approaches in economics.

Perhaps because it has such strong quantitative tools at its disposal, the disciplinary lens in economics education tends also to be quantitative. The correct objects for research about problem-based learning, however, are probably not grade outcomes, which are substantively the same for problem-based and traditional pedagogies. The literature lists a number of other valuable outcomes that problem-based learning could deliver in economics contexts, which in fact economics education research seems to be looking for as well; these should be the objects of research rather than a comparison of an outcome that the literature says should be substantively the same in either instructional technology. One of the reasons that Santos and Lavin (2004) must be equivocal about their findings is that they are asking the wrong question. Better use of the tools and discourse of the broader higher education literature would significantly revise our model of how learning happens in economics, hopefully taking the discourse to more productive conversations about novel pedagogies and what proficiencies matter in economics education.

The data presented here hint at the potential of problem-based learning to improve the quality of learning by fostering a number of valuable capabilities for economics graduates that may be absent in traditional instructional approaches, but it is only part of the answer. A more thorough triangulation of the course to confirm and contextualize the findings is the next step. Whenever assessing the merits of particular instructional technologies, economists should not let the discipline's quantitative methods orientation constrain the curricular questions explored. Qualitative methods and quasi-quantitative instruments are essential in order to provide evidence of the affective and ethical dimensions of the proficiencies that Hansen (1986, 2001) recommends for economics.

References

Albanese, M. A. and S. Mitchell, (1993), Problem-based Learning: A Review of Literature on its Outcomes and Implementation Issues, *Academic Medicine*, Vol. 68, No. 1, pp. 52-81.

Barrows, H. S., (1996), Problem-Based Learning in Medicine and Beyond: A Brief Overview, *New Directions in Teaching and Learning*, Vol. 68, Winter, pp. 3-12.

Becker, W. E. and Watts, M., (editors), (1998), *Teaching Economics to Undergraduates: Alternatives to Chalk and Talk*, Northampton, MA: Edward Elgar.

Becker, W. E., M. Watts and S. R. Becker, (editors), (2006), *Teaching Economics to Undergraduates: More Alternatives to Chalk and Talk*, Northampton, MA: Edward Elgar.

Biggs, J., (1996), Enhancing Teaching Through Constructive Alignment, *Higher Education*, Vol. 32, No. 3, pp.347-64.

Bligh, D., (2000), *What's the Use of Lectures?*, San Francisco: Jossey-Bass.

Blinder, A. S., (1991), Research in Economic Education and the Teaching of Economics, *Journal of Economic Education*, Vol. 22, No. 3, (Summer), pp. 251-254.

Bloemhof, B., (2012), A Study of Writing Assignments in Selected Canadian Undergraduate Programs, unpublished manuscript.

Brookfield, S., (2012), *Teaching for Critical Thinking: Tools and Techniquest to Help Students Question their Assumptions*, San Francisco: Jossey-Bass.

Chickering A.W. and Z. F. Gamson, (1987), Seven Principles for Good Practice in Undergraduate Education, *AAHE Bulletin*, Vol. 39, No. 7, pp. 3-7.

Coles, C. R., (1985), Differences between conventional and problem-based curricula in their students' approaches to studying, *Medical Education*, Vol. 19, No. 4, pp. 308-309.

Delva, M.D., R. A. Woodhouse, S. Hains, R.V. Birtwhistle, C. Knapper and J.R. Kirby, (2000), Does PBL Matter? Relations between Instructional Context, Learning Strategies, and Learning Outcomes, *Advances in Health Sciences Educations*, Vol. 5, No. 3, pp. 167-177.

Engel, C.E., (1997), Not Just a Method But A Way of Learning, chapter 2 in D. Boud and G. Feletti, editors, *The Challenge of Problem-Based Learning*, (second edition), London: Kogan Page, pp. 17-27.

Entwistle, N. J., (1987), *Understanding Classroom Learning*, London: Hodder and Stoughton.

Entwistle, N. J., (1997), Reconstituting Approaches to Learning: A Response to Webb, *Higher Education,* Vol. 33, No. 2, pp. 213-218.

Entwistle, N. J., (2010), Taking Stock: An Overview of Key Research, chapter 2 in J. Christensen Hughes and J. Mighty, editors, *Taking Stock: Research on Teaching and Learning in Higher Education,* Montreal and Kingston, Canada: McGill-Queen's University Press, pp. 15-57.

Entwistle, N. J. and P. Ramsden, (1983), *Understanding Student Learning*, London: Croom Helm; New York: Nichols Publishing Company.

Goodman, R. J. B., (2010), Problem-based learning: Merging of Economics and Mathematics, *Journal of Economics and Finance*, Vol. 34, No. 4, pp. 477-483.

Hansen, W. L., (1986), What Knowledge is Most Worth Knowing – For Economics Majors?, *American Economic Review,* Vol. 76, No. 2, (May), pp. 149-152.

Hansen, W. L., (2001), Expected Proficiencies for Economics Undergraduate Majors, *Journal of Economic Education*, Vol. 32, No. 3, (Summer), pp. 231-242.

Hattie, J., (2009), *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*, New York: Routledge.

Hmelo-Silver, C. and H. S. Barrows, (2006), Goals and Strategies of a Problem-Based Learning Facilitator, *Interdisciplinary Journal of Problem-Based Learning*, Vol. 1, No. 1, (Spring), pp. 21-39.

Kustra, E., (2009), *Using Problem Based Learning for Assessment in Large Classes: Triple-Jump*, Gloucestershire, UK: University of Gloucestershire. Accessed 23 November 2011 at http://insight.glos.ac.uk/tli/resources/toolkit/resources/alcs/Pages/PBLTripleJump.aspx.

Marton, F. and R. Säljö, (1976), On Qualitative Differences in Learning: Outcome and Process, *British Journal of Educational Psychology*, Vol. 46, No. 1, pp. 4-11.

Maxwell, N. L., J. R. Mergendoller and Y. Bellisimo, (2005), Problem-Based Learning and Macroeconomics: A Comparative Study of Instructional Methods, *Journal of Economic Education*, Vol. 36, No. 4, (Fall), pp. 315-331.

Mergendoller, J. R., N. L. Maxwell and Y. Bellisimo, (2006), The Effectiveness of Problem-Based Instruction: A Comparative Study of Instructional Methods and Student Characteristics, *The Interdisciplinary Journal of Problem-based Learning*, Vol. 1, No. 2, pp. 49-69.

Neufeld, V. R. and H. Barrows, (1974), The 'McMaster Philosophy': An Approach to Medical Education, *Journal of Medical Education*, Vol. 49, No. 11, pp. 1040-1050.

Norman, G. R. and H. G. Schmidt, (2000), Effectiveness of Problem-based Learning Curricula: Theory, Practice and Paper Darts, *Medical Education*, Vol. 34, No. 9, (September), pp. 721-728.

Painvin, C., V. Neufeld, G. Norman, I. Walker and G. Whelan, (1979), The 'Triple Jump' Exercise – A Structured Measure of Problem Solving and Self Directed Learning, *Annual Conference of Research in Medical Education*, November, pp. 73-77.

Perry, W. G., (1970), *Forms of Intellectual and Ethical Development in the College Years: A Scheme*, New York: Holt, Rinehard and Winston.

Perry, W. G., (1983), Foreword, in N. J. Entwistle and P. Ramsden, editors, *Understanding Student Learning*, London: Croom Helm; New York: Nichols Publishing Company, pp. vii-xiv.

Powles, A. C., N. Wintrip, V. Neufeld, J. G. Wakefield, G. Coates and J. Burrows, (1981), The 'Triple Jump' Exercise – Further Studies of an Evaluative Technique, *Annual Conference of Research in Medical Education*, November, pp. 74-79.

Rangachari, P. K., (1996), Twenty-Up: Problem-Based Learning with a Large Group, *New Directions for Teaching and Learning*, Vol. 68, (Winter), pp. 63-71.

Rangachari, P. K., (2000), Exploring the Context of Biomedical Research Through a Problem-Based Course for Undergraduate Students, *Advances in Physiology Education*, Vol. 23, No. 1, (June), pp. 40-51.

Regehr, G. and G. R. Norman, (1996), Issues in Cognitive Psychology: Implications for Professional Education, *Academic Medicine*, Vol. 71, No. 9, pp. 988-1001.

Roy, D., E. Kustra and P. Borin, (2003), "Who Takes Responsibility for Learning?" What is Unique About Inquiry? Available 25 March 2009 at http://cll.mcmaster.ca/resources/misc/whats_unique_about_inquiry.html#5.

Santos, J. and A. M. Lavin, (2004), Do as I Do, Not as I Say: Assessing Outcomes When Students Think Like Economists, *Journal of Economic Education*, Vol. 35, No. 2, (Spring), pp. 148-161.

Savin-Baden, M., (2012), *Piracy and Problem-Based Learning: On Stranger Tides*, keynote presentation at Competency and Problem-Based Learning conference (11-12 April 2012), Rovaniemi, Finland.

Savin-Baden, M. and C. Major, (2004), *Foundations of Problem-Based Learning*, Maidenhead, UK: Open University Press/Society for Research into Higher Education.

Shauer, G., M. Watts and W.E. Becker, (2008), Assessment Practices and Trends in Undergraduate Economics Courses, *American Economics Review*, Vol. 98, No. 2, pp. 552-556.

Siegfried, J. J., R. L. Bartlett, W. L. Hansen, A. C. Kelley, D. N. McCloskey and T. H. Tietenberg, (1991), The Economics Major: Can and Should We Do Better than a B-?, *American Economic Review*, Vol. 81, No. 2, (May), pp. 20-25.

Smith, T. M. and J. Ravitz, (2008), Problem Based Learning in College Economics, *Academic Exchange Quarterly*, Vol. 12, No. 1, (Spring), pp. 22-28.

Tan, O. S., (2004), Students' Experiences in Problem-Based Learning: Three Blind Mice Episode or Educational Innovation?, *Innovations in Education and Teaching International*, Vol. 41, No. 2, (May), pp. 169-184.

Vernon, D. T. A. and R. L. Blake, (1993), Does Problem-Based Learning Work? A Meta-Analysis of Evaluative Research, *Academic Medicine*, Vol. 68, No. 7, (July), pp. 550-563.

Walstad, W. B., Watts, M. and K. Rebeck, (2007), *Test of Understanding in College Economics Examiner's Manual*, (fourth edition), New York: National Council on Economic Education.

Watkins, D. A. and J. Hattie, (1981), The Learning Processes of Australian University Students: Investigations of Contextual and Personological Factors, *British Journal of Educational Psychology*, Vol. 51, No. 3, pp. 384-393.

Watts, M. and W. E. Becker, (2008), A Little More than Chalk and Talk: Results from a third National Survey of Teaching Methods in Undergraduate Economics Courses, *Journal of Economic Education*, Vol. 39, No. 3, (Summer), pp. 273-286.

Wiggins, G., (1993), *Assessing Student Performance: Exploring the Purpose and Limits of Testing*, San Francisco: Jossey-Bass.

Woods, D. R., (2012a), PBL: An Evaluation of the Effectiveness of Authentic Problem-Based Learning (aPBL), *Chemical Engineering Education*, Vol. 46, No. 2, (Spring), pp. 135 - 144.

Woods, D. R., (2012b), *Product-based learning, problem-oriented learning, problem-based learning, problem-based synthesis and project based learning. What's best for you?* presentation at CTE Cornell University, Ithaca NY.

Woods, D. R., (2011), *Measuring and Rewarding University Teachers to Improve Student Learning: A Guide for Faculty and Administrators*, Kowloon, Hong Kong: City University of Hong Kong Press.

Woods, D. R., (2006), *Preparing for PBL*, Hamilton, CA: Donald R. Woods/McMaster University.

Woods, D. R., (1994), *Problem-Based Learning: How to Gain the Most*, Waterdown, CA: Donald R. Woods.

Learning and teaching environmental technology in collaboration between university students and working life

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Problem-based learning (PBL) educates problem solving skills to the students. Students learn interaction skills by working in groups and solving problems together. PBL was suited to the workshop, the aim of which was to increase collaboration between students and enterprises in solving innovatively the problems of environmental technology. An important goal was to explore the learning outcomes through the learning diaries in order to help students to evaluate their own working skills and learning results. PBL strategy has become topical in technical universities, because students need also other skills than basic domain knowledge. The role of PBL could be stronger in engineering curricula. In making the role stronger, the teaching and learning experiences are needed to analyze obstacles in the use of PBL. In the organized PBL workshop, teachers, the project team, PBL expert and the company representatives, were participated. Experiences of PBL will help teachers in developing teaching practices towards student-oriented learning. Teachers should learn to give more responsibility to students on their own learning processes. Learning diaries of students are analyzed as the results of PBL workshop in this paper.

Introduction

PBL as teaching method has many variations and approaches. Different implementations of PBL offer applications to students to use learned knowledge in real-life problems (Hyppönen et al, 2009). PBL can give a foundation to the whole course or to curriculum. Benefits of PBL and project work are recognized in many papers, the results of which emphasize achieved improvements in group working, problem solving and professional skills (Brockman et al, 2002, Ribeiroa et al, 2005, Huntzinger et al, 2007, Du et al, 2009, Mälkki & Peltonen, 2010). The main nature of PBL challenges students to solve problems together and this improves also the social skills. These different skills are now topical in teaching (Crawley et al, 2010). Engineers are continuously facing new competence needs in working life (Oivallus Final Report, 2011). Students need education in preliminary capabilities, knowledge and skills to understand and solve technical, economical, ecological and social problems. Solving of global problems is also changing the teaching practices. PBL and other collaborative learning practices have become more and more useful at universities. Teaching trends are going towards more student-oriented learning practices, which enable self-directed and collaborative learning (Perrenet et al, 2000). PBL supports the student-oriented practices and offers a procedure for structuring and facilitating learning and group processes. Students learn to create, synthesize and share knowledge in groups. (Poikela & Nummenmaa, 2006). Chronological process in PBL helps to achieve deeper learning for multi-professional competencies. Working as a member of one group improves individual learning, and additional organizational learning occurs as a result of co-operation with the other groups (Öystilä, 2011).

Objectives

Objectives of PBL workshop, via the PBL strategy, for the university course in environmental methods, were the following:

- To connect PBL strategy into the firmer enterprise – student collaboration
- To generate new ideas for innovative development projects and topics for thesis
- To develop and to exploit the PBL workshop tool for environmental teaching
- To improve subject-specific skills and communication in environmental learning

PBL as a part of university course in environmental methods

PBL workshop was a part of the course organized in the Master´s Degree level university program in Aalto University. Aim of the course workshop was to introduce students into the principles of PBL strategy.

Problems originating from environmental work life were solved during the PBL tutorials. To tutorial, the responsible teacher of the course, other visiting teachers, the project team, expert training manager of the PBL strategy and representatives of companies were participated. Parts of the course were PBL was organized were as follows: orienting lectures held by responsible teacher and the visiting lecturers, students visit in an environmental laboratory, analysis demonstrations and writing of the learning diaries from context of the course.

PBL includes two tutorials. The first tutorial was traditionally arranged by their different phases during the starting of the course in the workshop and the feedback was given after the students had returned their learning diaries in own tasks in the second feedback tutorial. The independent brainstorming session of the ideas and formulating of the learning tasks for the further own learning were the parts of the PBL workshop. The original idea to start the brainstorming session discussions were the two sentences: "Bio and energy waste in households is dirty?" and "Too much food is being wasted at schools?"

In the second tutorial, students shared their learning experiences by discussions on their learning topics and the Moodle learning base and the responsible teacher´s concluding report from the results were exploited to each participant. Very important part of feedback was also the analyzing of learning diaries and the visualized results.

Profile of PBL Workshop participation

The active group of students, teachers and experts, who really wanted to solve and discuss about the waste problems, was participated in workshop. Profile of participants is in Table 1.

Table 1. Participant profile of PBL workshop.

Profile of participant	Number in PBL session	Type of company
Environmental waste management companies	2	From waste landfilling and logistics area
Food consulting companies	1	Consulting company from school food service
Adult students (from their own companies)	19	Adult students from Master´s Degree Program. Students work in many environmental companies & are from community sector
University project staff	2	From EcoMill project in Lahti. The official ESR-EU project behind the financing of the project
University teachers	3	Aalto University & Applied University of Lahti (LAMK)
PBL education experts	1	EDUTA Oy

Totally 28 persons participated PBL workshop session organized in the course of environmental methods. In session, the participants formed two separate discussion tables, and these tables had their own expert tutor, chairman and the secretary.

Result of PBL Workshop

Ideas of PBL brainstorming session for bio and energy wastes

Brainstorming session produced a wide range of other ideas and finally the learning task question for students´ independent own learning task. The most interesting ideas are in Table 2.

Table 2. Examples from key ideas from the brainstorming session for bio and energy wastes.

Nr	Idea	Comments
1	Development of technical composting in households is important	Composting is not yet sufficiently controlled. Freezing and heating can be controlled by new electrical innovations.
2	Information system for bio- and energy waste problems must be developed	System can be spoken about in newspapers, calendars, corporative web pages, in many campaigns etc.
3	Kitchen & laundry waste points and tube sorting systems must be developed.	To washing and sorting includes also textiles

Definition of student´s learning task for solving bio and energy waste problems

A lot of ideas were generated. Finally, the students concluded final case task for their own learning period. The actual learning task was presented in question form as follows: "Do we need a responsible person for households in department houses for bio and energy waste guidance and management?" The second interesting topics in evaluation and in competition with the final task above was the question: "Can the symbol marking of the packaging materials improve the waste handling system discussed about?" Immediate actions, based on student´s own task, in improving the utilization of bio and energy wastes, are in Table 3.

Acute outcomes from the learning tasks for improving the energy waste situation

Main ideas, which students presented as results in learning diaries from own learning task, are in Table 3.

Table 3. Main ideas from learning diaries in solving the problems of bio and energy wastes.

Number	Actions to be needed	Comments
1	Bio wastes needs its own regulation	Similarly the regional municipality and administrative involvements and obstacles should be investigated
2	Waste responsible persons should be selected	The majority of students say that this could be a good and effective tool for improving the collection management and improve the quality of the energy wastes
3	The person must have skills for the responsible work	Waste responsible person´s education and training must be arranged

Visualizing of learning task results in bio and energy wastes

One part from the students said in their diaries that the waste responsible person is not needed. Their opinion was that the development of the source separation is most important and for that, there is not any need for the separate responsible person. Then the key action to all waste problems in households is the better separation and partial washing of the wastes by the household themselves. To the system without separate waste contact person, were presented the following parts in housekeeping:

- The driver of a waste lorry can give more information to inhabitants
- Co-operation with waste management companies must be increased
- The place separation, recycling and the broader re-use must be increased
- The management fee system must be developed
- The safety of the processing of wastes at home with better hygiene must be trained

Majority of students, however, presented in diaries that the responsible persons are quite important, and that the more organized system model for the work of contact persons has to be developed. One, from results modified schematic presentation from the responsible person system, is presented in Figure 1.

The role of person, responsible for the energy waste management (see, Fig. 1), is important in the new waste management system which must be as economic as possible. This system produces cleaner energy waste for re-use and improves better the overall effectiveness of the system in recycling materials to re-use in communities.

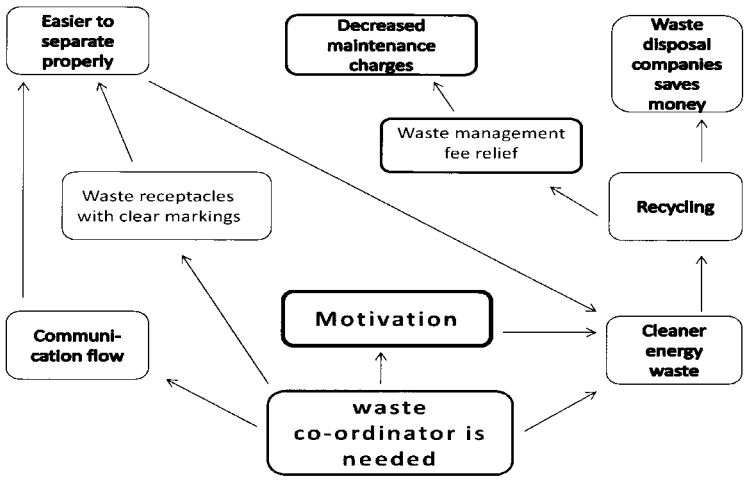

Figure 1. One from diary results modified visualization of the waste responsible person system.

Ideas of PBL brainstorming session for food waste problem solving

The surplus food is not possible to use further in Finland as well in the EU. This is due to the food legislation. Regulations present restrictions and requirements for the re-cooling of food, if the cold chain has been broken. This will also have impacts in the plans in decreasing the food waste like there is presented in Table 4.

Table 4. Examples of main ideas from brainstorming session results in school food problems.

Nr	Idea	Comments
1	Improvement of recycling of surplus food by using local food	Near-area (local) food origin is exploited. Farming business is increased. Surpluses are delivered to homes.
2	Frozen pre-prepared food service	For students there are served dishes from food automates as frozen semi-preparations. New refrigeration machines to schools.
3	Styling the space of food canteen in school	Food space must be more attractive, comfortable, lighter and not too noisy.
4	Removal of law barriers from food regulations together with new bio-waste regulation	More rational system.
5	Hygiene and pollution	Improvements in prevention and more ensure in hygiene.
6	Manner education to schools and homes	Forbid candy & soft drink automates. Competitions & incentives. Own planning group inside students. Rewards to chefs.
7	Information giving practices	Increased usage via computer tables

Definition of students learning task in solving of school food problems

The own learning task for students about the school food problems was defined by active table discussions. The task was finally formed to the question form like: "Removal of law barriers in food regulation makes the system more rational?".

The other target which competed with the above task was also a very interesting question: "The means and barriers in utilization of the surplus food and promotion of the use of the food from the local farms?"

Acute outcomes from learning task in solving of school food problems

Brainstorming session produced the actual main question above and in addition a wide range of other ideas. These ideas can be processed into many topics of environmental projects or to theses of studies between students and enterprises. The main other ideas are summarized in Table 5.

Table 5. Acute improvements based on learning diary outcomes results in school food problems.

Nr	Idea	Comments
1	New legislation for better usage of surplus food	Life cycle of food system without wastes in schools must be improved. Eatable food can't be ended to waste too early.
2	Better communication network between home and school	Food service screens to corridors of schools. Better-planned food portion orders in advance.
3	New food-service refrigeration automates to schools	Variety of semi-finished and frozen dishes to schools. Costs can be high and must be calculated.
4	More kitchen staff information and guides to students, teachers and parents	Attractiveness campaigns
5	Plan the meal just after the school sports	Students themselves decide the time on which they want to eat.

Visualizing of the learning task results in school food problems

Students visualized, see, modified Figure 2, some details, which have to be taken into account in minimizing the surplus food problem at schools. The whole food service chain has to be taken into account from primary production, the transferring of information between the food service and the home, the good manners in education and the appropriate cooling system in the food chain.

Food chain can also be associated with the idea, in which meals are delivered as a frozen form. Students visualized also the impacts of the school food waste system, when the food is prepared in the own school kitchen. Other remarks (based on Fig. 2) were the following:

The new food regulation is needed because nowadays too much good quality food is still wasted

- Semi-finished food portions are needed
- By the data systems, the needed food amount must be better to be ordered before hand
- The cooling system for food storage is expensive but its costs can be lowered by the better planning of the system

In Figure 2, the certain arrow signs highlight the number of the necessary steps to reduce all organic wastes in schools.

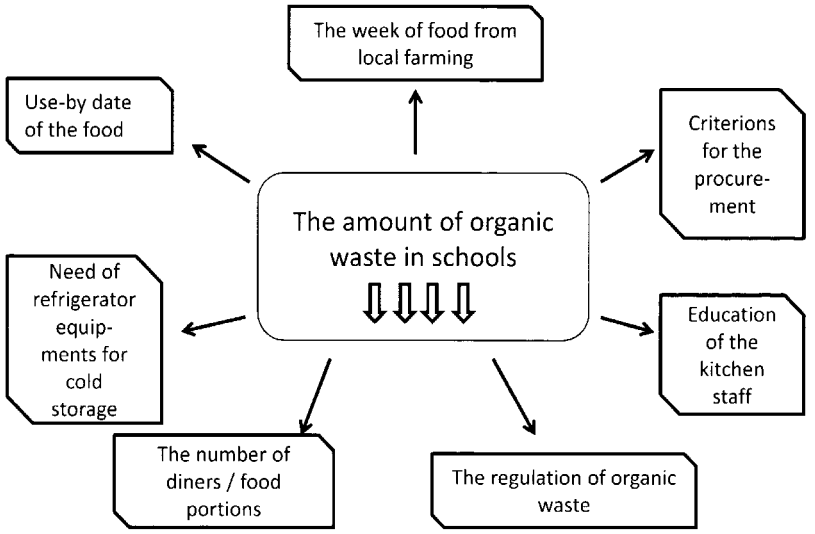

Figure 2. One from diaries modified visualization of the system in handling food surplus waste problems in schools.

Evaluation of PBL as teaching tool

PBL is well-suited for training of environmental engineering skills. Feedback of students and the responsible teacher increases the sharing of new information obtained from the task.

Benefits of PBL

Some benefits and opposite opinions of PBL workshop are presented in Table 6. Results are based on students average answers, asked for the separate questions by the responsible teacher, in the learning diaries.

Table 6. Students´ average thoughts about benefits of the interaction in the arranged PBL workshop.

Average benefit thoughts	Average opposite thoughts
PBL is useful in any creative field of environmental research & development. Good inspiration source in pre-planning phase of a project	PBL can increase of workload
PBL's application depends on company sector and attitude of the workplace	Business world is too busy and calls only for cost-efficiency
PBL approach helps to transfer old workers´ tacit knowledge to new before retiring	PBL as teaching tool is not as effective as traditional teaching by having the lectures
PBL suites in scope of environmental impact assessment	Context of PBL must be explained well to participants before the session
Team work, knowledge & teaching improvement	Brain storm phase could be shorter
Sharing of information in group and creation of new ideas is good	With smaller group exist more activated discussions

Conclusions and further visions

PBL workshop of EcoMill project gave positive teaching and learning experiences. Students used systematic brainstorming session in solving environmental problems of bio and energy and school food wastes. Their awareness of environmental, economic and social issues of problems was clarified. Collaboration with company tutors in workshop helped students to orientate in real-life problems. PBL seams to suite, e.g., for planning the waste management, to map company's environmental problems, to develop environmental methods and to pre-plan the project plan. The students mentioned that sharing responsibility is a good feature in PBL strategy. Teachers noticed that students were very responsible in their own learning tasks with good outcomes in their learning diaries. Students produced broadly a lot of innovative solutions and ideas for companies. These ideas can later on be generated into the new project topics. An obstacle of PBL in companies was, however, that they have not enough time and money to implement the total PBL strategy although they utilize brainstorming session. PBL strategy is good to be implemented to studies throughout the all modules of student's study curriculum and to enterprise collaboration. In the next workshop of EcoMill project, more opinions about PBL will be observed.

References

Brockman, Jay B., Fuja, Thomas E., Batill, Stephen M. (2002), A Multidisciplinary Course Sequence for First-Year Engineering Students, *Proceedings of the 2002 American Society for Engineering Education Annual Conference and Exposition,* Session 2253.

Crawley, Edward F., Malmqvist, J., Östlund, S. and Brodeur, Doris R. (2010), *Rethinking Engineering Education. The CDIO Approach*, New York: Springer Science + Business Media, LLC.

Du, Xiangyun., de Graaff, Erik and Anette Kolmos (Eds.), (2009), *Research on PBL Practice in Engineering Education*, Rotterdam: Sense Publishers, A C.I.P. record for this book is available from the Library of Congress, ISBN 978-90-8790-932-1 (e-book).

Huntzinger, Deborah N., Hutchins, Margot J., Gierke, Johns S. and Sutherland, John W. (2007), Enabling Sustainable Thinking in Undergraduate Engineering Education, International Journal of Engineering Education, Vol. 23, No. 2, pp. 218 - 230, TEMPUS Publications, Great Britain.

Hyppönen, O. and Linden, S. (2009), *Handbook for teachers – course structures, teaching methods and assessment*, Espoo: Publication of the Teaching and Learning Development Unit of the Helsinki University of Technology 5/2009, pp. 109.

Mälkki, H., Peltonen, P. and Karevaara, S. (2010), EcoMill as a platform for problem based learning in environmentally oriented product design, Presentation in the international *Conference of Engineering Education in Sustainable Development*, Gothenburg, Sweden, September 19 – 22, 2010.

Oivallus Final Report, 2011. *Competence Needs of Learning*. The Confederation of Finnish Industries EK. http://ek.multiedition.fi/oivallus/fi/index.php?we_objectID=152

Perrenet, J. C., Bouhuijs, P. A. J. & Smits, J. G. M. M. (2000), The Suitability of Problem-based Learning for Engineering Education: Theory and practice, *Teaching in Higher Education*, 5:3, 345-358.

Poikela, E. & Nummenmaa, S. (2006), *Problem-based curricula – theory, development and design*, Understanding Problem-Based Learning, Poikela, E. & Nummenmaa, A. R. (eds.), p. 75 Tampere: Tampere University Press.

Ribeiroa, Luis Roberto C. & Mizukamib, Maria Da Graça N. (2005), Problem-based learning: a student evaluation of an implementation in postgraduate engineering education, *European Journal of Engineering Education*, Special Issue: New Perspectives and New Methods in Engineering Education, Volume 30, Issue 1, 2005, pages 137-149

Öystilä, S. (2011), Ongelmaperustaisen oppimisen (PBL) perusteet ja syklin vaiheet, Lecture notes and slides in the course "Experimental methods in environmental technologies", Lahti 7.10.2011.

Promoting participatory learning opportunities in higher education

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Introduction

The purpose of this paper is to address the problem of learning in tutorials. We refer to learning from a context-sensitive perspective, regarding curricular strategies as well as the underpinning pedagogy. We argue in the paper that an extending process which uses one trigger for a sequence of tutorials supports the learning processes.

The co-authors of this article are colleagues who have been working with PBL since 1996. In an earlier paper (Silius-Ahonen & Rosengren, 2008), we presented a case study concerning the realization of PBL in the Social Services degree programme at Arcada University of Applied Sciences. The focal point was to highlight how problem-based curriculum planning processes were shaping a community of practice among teachers aiming at pedagogical development. In our different functions – as a lecturer, the head of the master degree programme in social services and as a senior lecturer in pedagogy, we all work as PBL-tutors on a weekly basis. Our interest in tutorials is therefore experience-based as well as theoretical and strategic. The current study belongs to a collaborative teacher team action research on our practice. Two posters were presented during the Competence and Problem-Based Learning (CPBL) Conference in Rovaniemi; Brantberg, Silius-Ahonen & Rosengren 2012 and Cederberg, Kiukas & Gustavson 2012.

Our first departure illustrates one alternative realization-practice of the tutorial process. Curriculum design promoting participatory learning opportunities is introduced as a platform where the tutorial is linked to other deeper processes, here called `deep-diving´ in learning.

Realization of the tutorial process

Post-modern comprehension of knowledge as contextual is not unambiguous. In a socio-cultural understanding, "context" consists of constraints. Knowledge deals with cultural agreements and when located in educational settings it forms a communicative, shared and mediated cultural practice, somewhere and during time. The definition of learning as an epistemic, dynamic and social act of transformation (Greimas, 1987) connects to the considerations of activity in social practice, where change of what is given is made possible. Lave (1993) refers to the epistemological problem of learning as a social praxis which concerns the concept of knowledge. Learning as a dialogic exploration requires personal judgments, while knowledge is contextualized by cultural agreements. How are we then designing opportunities for learning that qualify the student for professional work and yet do not leave out the other purposes that Biesta (2010) refers to, socialization and subjectification?

On our degree programme in social services, students participate in modules where theory and skills are integrated into competences around themes covering the main aspects of the future profession. Most of the courses are cross-disciplinary. In the beginning of a course, students are offered a guide, which provides information about the learning objectives and outcomes of the module, scheduled activities (i.e. lectures, workshops, study-visits, seminars, and examinations etc.), key concepts, criteria for assessment and a range of references.

The tutorial, at the core of the student's learning process, consists of about 6-8 students and a tutor who usually meet twice a week, and later on every other time without a tutor, and in the very last course the students work by themselves. The students decide upon a contract with a pedagogical and social learning agreement, in order to foster trust among the participants. During a 1.5 h session, the students elaborate theoretical or practical problems based on scenarios of relevance to real-world problems. The curricular strategies are formulated by a team of teachers who are involved in the module. Roles are only adopted when they are found to be motivated from a group dynamic and pedagogical point of view. Various methodological choices are made by the tutor in her/his mediating practice. To be able to identify what kind of new problem to tackle is hidden in the scenario, and the students share some previous experience and former knowledge on the matter or context.

Creation of learning experiences in tutorials

The quality of the problem plays an important role in building up a functional PBL environment. Collaboration between education, stakeholders and users in the curriculum planning determine the purpose of qualification. Learning by real-world problem solv-

ing in tutorials provides a rich context with deep meaning for students as they search for solutions to problems and issues of concern to themselves and to the community.

Instead of short time triggers, a scenario that triggers processes for approximately six tutorials is practised. This strategy is chosen so as to enhance students´ deeper learning and understanding. The point we are making here is that the tutorial is also a real-world context, analogous to the world outside the institution. We do not learn in a vacuum, but rather located and placed in a situation, a setting with other people, related to a specific context. A tutorial is shaped as a learning space, where knowledge is constructed on a personal and participatory basis. It is constituted by the time span, the transformative experience and epistemic meaning making in that context.

Knowledge is therefore constructed by participants through actively relating what they have studied to their personal experience. The curriculum as a template, a framework placed in a situation, becomes a setting of activities to shape learning opportunities. Learning outcomes are not seen to be the limit for inquiry, but they demarcate qualifications that are required in the professional field. Students (of all age) need protection from destructive group-dynamics and need guidance into productive dynamics. Emotions of insecurity in situations create open spaces for experimental thinking and expansion of creativity. A balance between "feeling safe" and "puzzled" is to be created. This requires an environment where sharing becomes a familiar procedure. By mediating, the tutors can create an atmosphere in the group where it is permitted to both succeed and make mistakes, as well as to explore new areas.

A crucial topic in higher professional education is the enactment of personal knowledge in social practices. Our suggestion works against an instrumental misinterpretation of problem solving. By extending the interpretation of learning outcomes to consider students´ capacity to reflect and reason on the sustainability for real-world problems, a larger scale of perspectives is brought about. Tutorials are dynamic and open up liminal spaces for learning processes. Setting a platform where new knowledge is to emerge in collaboration, the emphasis is put on the tutorial as a living situation for expansive inquiry.

According to Dewey (1938, 105-111), inquiry and questioning up to a certain point are synonymous, but inquiry encourages the learner to be uncertain, unsettled, and disturbed. To see that a situation requires inquiry is the initial step of learning, where forming ideas is anticipation, and it thus marks a possibility. When a suggested meaning is immediately accepted, inquiry is cut short; it is not grounded even if it happens to be correct, but when it is more clearly relevant to the problem in hand, the meaning is finally reached.

Students need therefore to be encouraged and given time to try different approaches and solutions. The professional social pedagogue is one that has a deep understanding of and ability to facilitate various people of all age groups, often being in vulnerable life situations. Therefore, there should be space for many opportunities to delve deeply for the purpose of avoiding fragmentation of the repertoire of professional knowledge.

By extending the time for the groups working on every individual problem there will be time and opportunities for knowledge construction in a different way than if new triggers are presented every second week. To be able to cope in working life, students require more than just skimming through an area as wide as possible. The core point will be on understanding the phenomena and then applying that understanding in other parts in the professional context. Having enough time to view professionally relevant "phenomena" from multiple perspectives prepares students for future knowledge construction.

The tutorial design

A tutorial is to function as a dialogic setting where participants articulate their own voices. It is the responsibility of education to provide curricular arrangements that make it possible for participants to come forward with their unfinished thoughts, questions, and doubts. Tutorials are therefore seen as platforms for learning, which offer something other than meeting points for students to merely share their self-studies. Barrett (2006), reasons on the concept of "problem" in a PBL-setting. It should function as a provoker of liminal space. She refers to the dialectic between current knowing and what is yet to be known. Relating to the space betwixt and between knowing, doing and being she reflects on three dimensions, of knowledge, professional action and identity which are the basis of professional education. Knowledge creation acted out in dialogue move students´ meaning perspectives. Different directions of acts, (multimodality and polycentrism) are liminal in their transcending capacity. Dialogic events are open and polyphonic properties of cultures (Bachtin, 1988). Transformation requires an unsettling of former meaning perspectives, where activities that push students beyond these perspectives provide vehicles for transformation. Participants´ current frameworks for making sense of that experience demonstrate the social nature of knowing and coming to know (Wells, 2002, 2).

The extended process promotes the tutorial group to a deeper delving as it allows sufficient time to explore the problem from different points of view, not hurrying towards snap conclusions, but getting a more holistic approach to the problem. Participants celebrate in beginning a process. They find new questions to deal with as the topic is opened up and made urgent for them as inquirers, which helps them to avoid simple models of explaining the world. One of the tutor´s challenges is to mediate with key questions, which enable an atmosphere of inquiry.

The tutorial as experience

A challenge for the students is to get involved in self-studies and other activities around the tutorial. For the tutor it is important to direct the flash towards inquiry and inspire authentic questioning. The challenge for young students is to accept and embrace uncertainty in the beginning of a process. Accountability for the whole group as commitment, positive social interdependence requires what Sahlberg (2000) calls a healthy psychological climate where all students participate in the negotiation. Sahlberg (op.cit.) states that positive social interdependence needs to be structured in the groups as it does not appear automatically. They develop critical thinking when they negotiate on, not about, the topic. Experience of collaborative work promotes a willingness to get oneself emotionally involved in the tutorial. Group dynamic role-taking, as in any team, with the sharing of ideas and beliefs that emerge from recently read literature develops listening and other interactive skills. Whether a tutor mediates by evoking difficult questions, challenging the meta-theoretical level, or elaborating, an epistemic work is triggered.

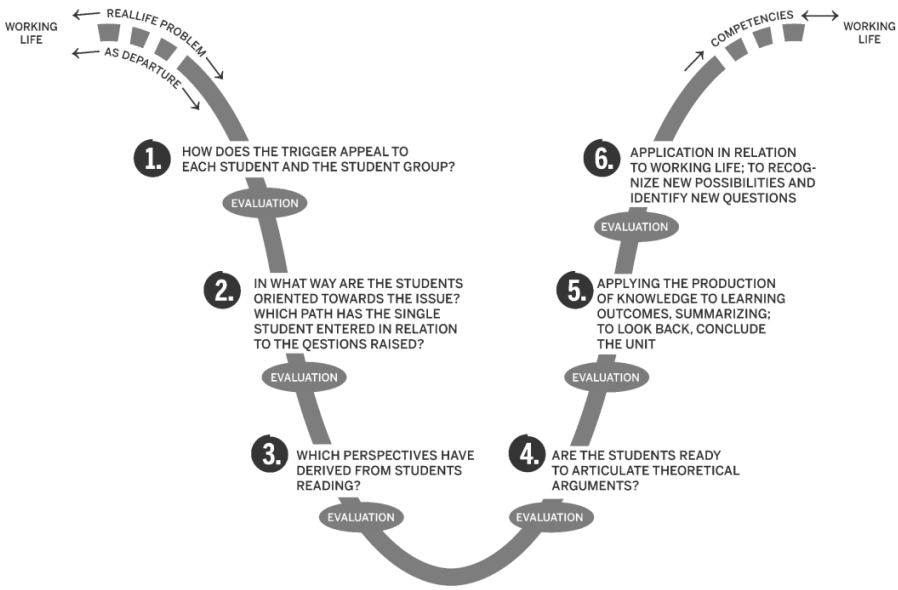

Figure 1. Deep-diving process in tutorials

A tutor can contribute in an integrated manner to working life by bridging the educational and the professional world. Grasping and clustering issues that students come up with are aimed to contextualize fragments of theories. A tutor´ s preliminary closure of a tutorial process "this is where we are here and now, and it is sufficient"

confirms for the students that learning is a continuous dialogue. A collective multimodal process is significant for developing students' critical thinking and reasoning skills when dealing with professionally relevant situations or problems. This process then, is significant in enhancing independent responsibility, a personal commitment and self-directed actions of exploring in a mutual, dialogic arena.

Learning as transformation

An empirical study on negotiation in PBL-tutorials demonstrated learning as transformation in situ. However the processes of learning are complex and deeply personal, they are neither found hidden in the heads of the participants, nor are they too tacit to reason on. Performed in-situ action – coming to know and coming to understand were visible in the verbal and non-verbal expressions. The formation of new ideas, insights, and an understanding of how phenomena were related unfolded on the video-tapes. When a learner in a PBL-tutorial is trustful enough to risk her/his safety and engage in the risky undertaking of a learning process, which is a confrontation between the learner's former knowledge and the potential knowledge in that specific context, links emerged of both collective and personal significance. The so-called "stupid questions" seemed to fuel transformation (Silius-Ahonen, 2005). As "trans" refers to liminality, a collective experience where individuals go beyond themselves (Turner 1982), collaborative learning in social practice constitutes a clash between reflection, knowledge claims and the meaning-making processes. A premise for climbing the threshold (a metaphor from Bachtin 1988) was the emergence of a creative gap, a liminal space, a place of uncertainty in relation to involvement. In the tutorial, production of knowledge emerges due to the art of negotiation. (Silius-Ahonen, 2005)

Curricular strategies promoting working life competences

During recent years European higher education has witnessed a great paradigm shift from a teaching-centred to a learning-centred and competence-based approach, which takes into account and supports the personal and professional growth of the student. Higher Education Institutions (HEI) are moving from the fragmented atomistic curriculum based on separate subjects and disconnected courses towards a holistic competence-based curriculum (see ARENE 2007).

The learning process is supported by learning situations that promote student activity and reflection. The students' prior knowledge, skills and attitudes in relation to the targeted learning objectives and outcomes in terms of competences all make the foundation for the curriculum design (ARENE, 2007). Regarding the concept of competence as "prepared to act in a capacity", the action is emphasized. Curricular

strategies that open up arenas for participatory learning opportunities enable constraints to act as vehicles instead of mere regulations. In higher professional education, curricular strategies mark arenas where competences of professional relevance are fostered. The competences, that lay the formation for the curricula, are understood as combinations of knowledge, practical skills and attitudes, all of which count in the real world of practice.

At the professional universities this educational structural change has entailed flexibility, integration of subjects, working-life orientation, and Research, Development and Innovation (RDI) centeredness of the curricula. It is the team of teachers' task to create learning environments and situations, and coach and examine, in ways that support the learning process of the individual student and student community.

We find that a discussion on PBL is beneficial for pedagogical development in the whole field of higher education. Curriculum-planning theory has often been dominated by conceptions derived from administrative perspectives on planning (Reid, 1994). The disciplines behind a profession shape an epistemological foundation for the planning process which is not always in line with pedagogical thinking. Silén (1996) notes three main roles in a PBL design for the teacher: the facilitator, the creator of learning experiences and the designer for learning. Nummenmaa et al. (2005) ask what kind of expertise and competence education should develop. Poikela & Poikela (2005) emphasize the idea of curriculum as a strategic answer to competence needs in our society. Education itself produces knowledge by the production of competences. The shift from knowledge as the focal point of curricular interest to knowing is a consequence of a greater shift of paradigm, referred to as going into the post-modern era.

Underpinning presuppositions and theoretical standpoints are always embedded in the decision-making processes of curriculum formation. Curriculum planning as a practical matter is based on theories of action, and consequently its central task to define the desired outcomes of an educational effort goes beyond mere pursuit. Formulating events and situations as settings for the actions develops the curriculum format. Planning processes for study activities are pedagogical strategies with a double significance. Their obvious target is the students, but they also manifest the learning culture for teachers as well. Curricula therefore constitute learning processes among teacher teams themselves.

We argue that educative processes can be linked to the rhetorical use of the concept "competences" through the key-word participation. A teacher team working with pedagogical development offers learning experiences and enhancement of curricular thinking. People who share a concern, a set of problems, or a passion about a topic, deepen their knowledge and expertise in this area by interacting. They accumulate

knowledge; they become informally bound by the value that they find in learning together. Over time, they develop a unique perspective on their topic as well as a body of common knowledge, practices, and approaches. They may even develop a common sense of identity and become a community of practice. (Wenger et al. 2002, 4-5). Curricular planning deals with concrete practical matters as well as epistemological choices. This remark is not self-evident as practicalities and particularities are often found working against autonomy in higher education. Firstly, curriculum makers have to balance between the real-world problems that our society confronts education with. In higher professional education, these problems are complex and require complex platforms for negotiation. An individual student is to face professional demands which constitute something other than a mere option to choose between educational offerings. If student involvement in education is understood from the neo-liberal perspective of consumers, then educational strategies become products where students are readily seen as course shoppers.

However, a PBL-curriculum is aligned with some of the concepts from the Bologna-process. One of the concepts, competence, has a relevance of qualification where the legitimacy of formulating learning outcomes is seen as a process of collaboration between a working field, educators and students. For curriculum planning and educational policy, it is of relevance to accept the importance of the culture of learning arenas, including the physical place and virtual space for learning as these factors penetrate the learners' as well as the teachers' minds and actions. A community of praxis is seen as a goal for the team of teachers in their own doing and reflective learning process.

Congruence between what a teacher articulates and how s/he acts is a core value in the identity of a teacher. Problem-based learning as an educational setting offers several kinds of structuring ingredients. The curriculum offers repertoires of reflective practice to trigger transforming learning experiences in various environments. Creating new forms of assignments will influence the student community as a whole. The purpose of communities of practice among the students, in and outside tutorials, is supported by occasions like cross-tutorials and small seminars. Students´ collective production of written texts gives an opportunity for collaborative work as a production of knowledge. These products foster the sense of responsibility as they have been conducted in manners of commitment and reflective learning. The feeling of inclusion is the one that leads students to actively participate, and participation enhances inclusion (Lave & Wenger, 1991; Wenger, 1998). Shared rewards and peer assessments are tools for promoting co-operation. In order for a team to act towards mutual goals, team-building efforts have to be designed and practised beforehand.

Critical questions that arise are, for example: what kind of classrooms and buildings (physical learning environments), curricular decision-making and agendas, promote

improvisation in negotiation on knowledge matters? How do artefacts and fixed furniture layouts influence the representation of knowledge? How does the rhetoric of collaboration match the factual responsibility of the participants? What kind of epistemological choices are imposed? How does the form of knowledge implied construct potentialities of learning? What kind of action helps the student to enter the educational setting? It is therefore found important to strive for arenas where knowledge is authentically negotiated. Which time is required to elaborate these issues? Which surrounding is suitable for negotiation? In advance, curricular strategies are made to set the occasions by scheduling them in a programme. Commitment towards team-working grows by participating in teams. Determining the goals for the work with a mutual interest is the result of negotiations, and time-consuming activities are necessary for these efforts.

The design of learning environments according to our experience is a choice of lenses through which information is represented and exposed in teaching: activities are conducted, interactive tasks are set for the purpose of a variety of modes, communication is shared, and the training of social skills for the voices to be heard and the epistemological choices regarding how knowledge can possibly be performed and examined take place. As teachers and researchers we ask:

- What kind of agenda? For what reason and from what perspective is it chosen?
- Why these objectives, these learning outcomes?
- How are we designing the setting of activities? Which eco-system of participants will formulate the problem?
- Which is the hidden ideology behind our curriculum?
- What do we expect a learner to act upon in practice?
- How do we present the form of knowledge that the theme refers to? What kind of representation language do we use – iconic, narrative, or technical equipment? Do we use scenarios written on paper, watched on video, observed in-situ or role-played?

In Table 1, we highlight issues in curricular planning and in the creation of learning experiences in tutorials that promote participatory learning opportunities. We argue that the activities, situations and settings that promote participatory learning opportunities are to be designed. The problem of curriculum making is neither a practical realization of specific disciplines nor a management procedure.

Table 1. Curricular strategies promoting participatory learning opportunities

Curricular strategies	**Structure and liminality**	**Design**
Designing for learning	**Curriculum constructors**	**Realization**
Who?	Multiplicity of voices	Teacher community Students (different group formations) Partners in the professional field
When?	Dramaturgy of events	Scheduling, timing
What?	Learning objectives, examination criteria and literature options	Places for anchoring
	Qualifications – re-construction of knowledge Producing knowledge in collaboration, reflecting in and on action	Assignments and Examinations Settings (lectures, tutorials, workshops, seminars, practical training, resource occasions, study visits)
Where?	Sites, locations, situations	Learning spaces (physical, virtual) and cultural circumstances)
Creations for learning experiences in tutorials:	**Teacher team**	**Learning outcomes: the student**
Scenarios, triggers	Problem context Creative inspiration Involvement	- recognizes problems and puts authentic questions to the professional field - develops meta-cognitive skills
Self-, peer-, tutor- evaluation and feedback	Knowledge production Process of sharing	- formulates stances in dialogue with discursive knowledge - reflects on the epistemic work. socio-emotional support, procedures and distinguishes between the aspects - reasons on issues from various theoretical perspectives
Learning agreement in the tutorial group	Group contract to encourage and structure the work	- shares information, listens and is committed to teamwork - develops interactive skills
Negotiation on topics	Co-construction of knowledge	- elaborates theoretical statements for understanding and access to cultural practice

An enhancement of marking participatory activities in the curriculum does not diminish the agency of the student. The purpose of participation is to involve students in dialogues according to the mutual agenda, professional and personal development and growth. Innovations are often requested in the educational discourse of today. Still, when creativity is set into motion it is not always welcome because it might disturb mechanical and habitual thinking. Sometimes, creativity that has actually occurred is not noted on a larger scale because it appears in small classrooms with young people discussing matters of importance and nobody outside comes to know about these peak experiences.

Conclusions

In a PBL setting, the role of socialization is stressed as students collaborate as if in a team in the working field. Participation is nested in the idea of community of practice. In this sense, partnership with the professional field contributes to the purpose of qualification. Meaningful learning experiences are found to touch the process of becoming a subject. A dialogical approach – in a broad sense – widens the developers´ views on how to promote transformative processes by participation. A precondition for shaping tutorials as dialogic arenas in the sense of multi-voiced places seems to be that teacher teams also make sense and meaning in arenas designed for their involvement.

If the pedagogical planning processes among teachers, or tutorials with students, are too strictly structured, the liminal space is difficult to spot and validate. The experience of inquiry relates to a possibility zone of learning. Contradictions in mental scenarios set reflection in motion when they are shared and articulated. The "movement" of transformation requires improvisation, imagination and a climate where trying out solutions is trustful. We have found that a `deep-diving´ inquiry (see Figure 1) has had a positive impact on students´ ability to reflect and to use theoretical statements as their own understanding. The tutor´s scaffolding without a "know-all" attitude is found especially relevant for promoting the expansion of meaning perspectives among students. When students are able to identify different perspectives and approaches to theory, challenging questions and key concepts give them a chance to deepen their reasoning. The "subjectification" of participants is therefore always related to the community, the shared arena. Participatory activities and events are to be designed as arenas for negotiation and a down-to-earth understanding of action that involves the whole person, not only the mind. When tutors themselves cope with insecurity and celebrate unpredictability the students dare to enter an authentic inquiry.

References

ARENE. (2007), *Ammattikorkeakoulut Bolognan tiellä. Ammattikorkeakoulujen osallistuminen europpalaiseen korkeakoulutusalueeseen*. Projektin loppuraportti. Helsinki: Arene.

Bachtin, M. (1988), *Det dialogiska ordet*. Gråbo: Anthropos.

Barrett, T. (2006), A problem as a provoker of a space betwixt and between old and new ways of knowing. In E, Poikela & A.R. Nummenmaa (eds.), *Understanding Problem-Based Learning*. Tampere University Press, pp. 33-50.

Biesta, G.J.J. (2010), *Good Education in an Age of Measurement. Ethics, politics, democracy.* Boulder, Colo: Paradigm Publishers.

Brantberg, B., Silius-Ahonens, E., Rosengren, Å. (2012), *Perspectives on using one trigger for a sequence of tutorials in a PBL curriculum.* Poster presentation at the Conference Competence and Problem-Based Learning - Experience, Learning and Future, Rovaniemi, Finland. 12 April 2012.

Cederberg, A. Kiukas. C., Gustavson, M. (2012), *A method for reflecting and strenghtening students´ learning and self-regulated learning.* Poster presentation at the Conference Competence and Problem-Based Learning - Experience, Learning and Future, Rovaniemi, Finland, 12 April 2012.

Dewey 1938/1960, *Logic. The theory of inquiry*. New York: Holt.

Greimas, A. G. (1987), *On meaning. Selected writings in Semiotic Theory.* London: Frances Pinter Publishers.

Lave, J. (1993), The practice of learning. In S, Chaiklin, & J. Lave (eds.), *Understanding practice: Perspectives on activity and context*. Cambridge: Cambridge University Press. pp. 3–32.

Lave, J. Wenger, E. (1991), *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Nummenmaa, A-R., Karila, K., Virtanen, J., Kaksonen, H. (2005), Negotiating a Problem- Based Curriculum – a reflective learning process renewing the culture of teaching and learning. In E. Poikela. & S. Poikela, (eds.), *PBL in Context. Bridging work and education*. Tampere University Press, pp. 45-66.

Poikela, E. & Poikela, S. (2005), The strategic points of Problem-Based Learning – organising curricula and assessment. In E. Poikela & S. Poikela, (eds.) *PBL in Context. Bridging work and education*.Tampere University Press., pp. 7-22.

Reid, W.A. (1994), *Curriculum planning as Deliberation*. Oslo: Universitetet i Oslo, Pedagogisk forskningsinstitutt. Rapport nr.11/1994.

Sahlberg, P. (2000), *Critical elements of learning groups.* Paper presented at the Conference on Innovations in Higher Education, Helsinki 31.8-1.9.2000. Accessed 12 March 2012, <http://www.pasisahlberg.com/downloads/Inno%202000%20paper%20Final.pdf>

Silén, C. (1996), *Ledsaga lärandet – om handledarfunktionen i PBL*. Licentiatarbete.. Linköping: Linköping universitet, Institutionen för pedagogik och psykologi.

Silius-Ahonen, E. (2005), *Lärande som text. En dramapedagogiskt förankrad läsning av det kroppsliga, rumsliga och retoriska i kunskapsbildande processer.* (Diss.) Åbo Akademis förlag.

Silius-Ahonen, E. & Rosengren, Å. (2008), *Towards a learning centered and competence-based curriculum in Higher Education. Problem Based Learning Strategies at Arcada University of Applied Sciences*. Paper presented at the Eighth Conference on Problem-Based Learning in Finland. Tampere, 2008 April 3.-4. Accessed 2 October 2011, <http://www.uta.fi/esuta/probell/seminars/2008/esitykset.html>

Turner, V. (1982), *From ritual to theatre: the human seriousness of play*. New York: PAJ Publications.

Wells, G. (2002), Learning and teaching for understanding: the key role of collaborative knowledge building, *Social Constructivist Teaching*, vol. 9, pp. 1–41.

Wenger, E. (1998), *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.

Wenger, E., McDermott, R. & Snyder, W. M. (2002), *Cultivating communities of practice: a guide to managing knowledge*. Boston, MA: Harvard Business School Press.

Problem solving and learning in mathematics

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> *"Even fairly good students, when they have obtained the solution of the problem and written down neatly the argument, shut the books and look for something else. Doing so, they miss an important and instructive phase of the work… A good teacher should understand and impress on his students the view that no problem whatever is completely exhausted. One of the first and foremost duties of the teacher is not to give his students the impression that mathematical problems have little connection with each other, and no connection at all with anything else. We have a natural opportunity to investigate the connections of a problem when looking back at its solution." (Polya 1981)*

Introduction

Two different competing theories on how we acquire knowledge have been predominantly present in modern pedagogy. One is the concept of cognitivism, the other one that of constructivism. The cognitivist paradigm essentially argues that the "black box" of the mind should be opened and understood. The learner is viewed as an information processor, like a computer. Knowledge can be seen as symbolic mental constructions. Learning is defined as change in a learner's mental model of aspects of the world or of the self as to facilitate the processes of cognition and perception. (Pilat 1999 & Spitzer 2002.)

Constructivism can be described as a theory that deals with the way people create meaning of the world through a series of individual 'constructs'. Constructs are the different types of 'filters' we choose to place over our reality from chaos to order.

Both these learning approaches base on two major types of knowledge: qualitative and quantitative. However, what adds a third major category to this domain is distributed knowledge, knowledge that could be described as connective. Connective knowledge requires an interaction, it is knowledge of the connection: a property of one entity must lead to or become a property of another entity in order for them to be considered connected. (Downes 2007)

Connectivism stresses that the two important skills that contribute to learning are the ability to seek out current information, and the ability to filter secondary and extraneous information. Simply put, the capacity to know is more critical than what is actually known. Learning is considered a knowledge creation process, not only knowledge consumption. Knowing where to find information is more important than knowing information. (Kop & Hill 2008)

Towards Problem-Based learning

Problem solving, where learning is understood as knowledge creation process, not only knowledge consumption, thrives on the concept of connectivism.

> *"Great discovery solves a great problem, but there is a grain of discovery in the solution of any problem. Your problem may be modest, but if it challenges your curiosity and brings into play your inventive faculties, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery. The first rule of discovery is to have brains and good luck. The second rule of discover is to sit tight" (Polya, 2004)*

Introducing the problem-based approach to learning in the courses of mathematics at our university has opened a new dimension to student knowledge acquisition. This is a pilot programme which is currently run only for the students doing their major in the domain of management, where mathematics easily finds many practical applications.

However, we can notice even at this early stage that the programme is bringing a lot of benefits to all parties involved. It gives the students the feeling of reward stemming from collaboration with and supporting others to achieve meaningful goals. For the teachers, who are supporting and encouraging the students in their project work, it brings along the tangible results – students' higher performance, enthusiasm, and,

surprisingly, even better understanding and application of mathematical theorems and formulas, when compared with the students participating in traditional courses.

The programme Problem-based Learning in Mathematics runs for four semesters in the first and second year, first cycle, B.Sc. courses. In the course organisation we make sure that:

- Students are put in several small teams of 4-5 students each
- Each team works on short-term problems of lower level of difficulty
- All teams are independent and they work on differentiated mathematical problems
- Students compare results and review different methods they used
- Teacher plays the role of the coach and facilitator who inspires, motivates and directs
- in the first stages of work
- Students gain all information and tools necessary for solving problems through teacher's observation, team work, and individual involvement
- Students get a chance not only to master skills in mathematics but also in team building and a selection of other soft skills indispensable I work place situations

In the second year of their PBL in Mathematics course (semester 4) students do larger projects lasting 15 weeks. Those differ in the length and problem complexity. All project teams are assigned obligatory 30 contact hours with their supervisors who facilitate their project work involving mathematics. At the same time, however, all teams working on projects, or problems, are assigned another obligatory 45 contact hours with the instructor in Team Building and Communication Skills.

Learning team work

The idea of combining PBL in Mathematics with Team Building and Communication Skills course came up when we observed that the first-year students working on mathematical solutions do not know how to take a full advantage of the team potential, the fact that they can work together on solving problems. They did not know how to change their groups into effectively working project teams. The Team -Building and Communication Skills is the course which provides students working on a project with tools necessary for building an effectively functioning team, that is such that can identify where their strengths lie, and where there are areas for improvement. Mastering this kind of skill is especially important for students doing their major in management. Corporations today place a big emphasis on interpersonal skills and greatly recognize the value of synergy that stems from team work.

The students learn to understand the benefits of team work in solving mathematical problems. They learn about team transformation throughout different stages of its development, the team dynamics; they look at the team as a mixture of skills and behaviours so that they can divide roles and share workload more effectively. Therefore, the students working on project teams learn:

- how to organise and improve communication
- how to prepare for and conduct their meetings to make them efficient and productive
- how to write a professional report presenting the outcome of their project
- how to deal with conflicts to make them constructive
- how to work in a multinational team with people of different cultural backgrounds
- how to work on improving motivation and creativity on teams
- what are the leadership styles
- how to manage the project
- how to use tools for planning and time management

Following the guidelines set by Howard Barrows, the pioneer and inventor of the Problem-Based Learning approach in teaching, we observe the basic principles in our PBL in Mathematics course organisation (Barrows & Tamblyn 1980):

- students are allowed to engage new information in the context of solving authentic problems rather than be presented information in a decontextualized, discipline-based way
- teaching is organized in a way that emulates the reasoning of a skilled practitioner
- in the course of exploring a problem, students in a PBL curriculum identify deficiencies in their understanding and identify their own resources for redressing these deficiencies
- simulated situations are used to test the students' interactional and problem-solving skills

Students are evaluated twice during the semester: in mid-term and final presentations. Presentations are held in front of audiences composed of project supervisors, team-building instructors, and students from other teams working on other projects. Thus students are evaluated not only by the teachers but also by the peers. In semester 4, on the successful completion of both courses combined (PBL and Team Building and Communication Skills), the students are awarded the total of 24 and 3 ECTS points respectively.

Examples of short-term projects for the first-year students give a picture of the variation of project tasks:

1. *State and find strategies for solving different variations of Tower of Hanoi puzzle. Assume: the existence of more than three pegs restrictions of moves disks may have the same size.* (Requires: Combinatorics, Recurrence relations, Mathematical Induction)
2. *Use propositional calculus and theory of quantifiers for the description of a Shakespearean sonnet. Use the law of logic and prove some limericks. Find the method of proof used in limericks.* (Requires: Propositional Calculus, Inference methods, Logical reasoning)
3. *Construct an algorithm that can be used by a pilot while descending. Where should the pilot start descending?* (Requires: Differential Calculus of one variable)
4. *Invent a theory for calculating the limits of indeterminate symbols without the aid of L'Hospital rule.* (Requires: Taylor and Mclaurin formulas and series)
5. *Find the rule describing the growth of the human brain.* (Requires: Antiderivatives, Separable and linear ordinary differential equations)
6. *Explain the shape, location and colours of rainbows.* (Requires: Differential and Integral Calculus of one variable)
7. *Catalan sequence versus Fibonacci sequence. Popularity contest.* (Requires: Z transform, Recurrence relation, Combinatorics)

An example of a larger project for second-year students can be the problem of:

> *How to elect a rector of the Lodz Institute of Technology? Model a voting system satisfying the greatest number of criteria of fair elections and reflecting the will of the people. (Requires: Discrete Mathematics, Optimization, Confidence Intervals, Testing Hypothesis)*

Conclusions

There are many problems we, teachers, are facing when designing the PBL in Mathematics curricula and outlining organisational guidelines targeting the students of management. Questions about the fair and objective forms of appraisal and grading criteria seem to be of the biggest urgency. Similarly, preparing problem scenarios at differentiated levels of difficulty is another challenge. The good perception of ideas associated with engineering and their application in the general management as well as the flexibility in the interdisciplinary science environment are the main guidelines in scenario preparation. As the duration of the full PBL course in Mathematics is four semesters, therefore we start from easier projects involving basic mathematical tools connected with differential and integral Calculus. Later on, with the course development, we extend the study area to the various aspects of economics, management, marketing and decision making. Examples of the forthcoming

projects which are closely related with the integrated educational learning outcomes could be the following three:

1. GPS algorithm for covering all places of interest at the Lodz University of Technology campus.
2. Optimal management of the parking lots at the Lodz University of Technology campus
3. Game theory applied to the fair competition between canteens operating in student dormitories.

Our study course is only in a transitional stage towards the PBL pedagogy now and we hope that in one year time we will be able to assess the completed course using both qualitative and quantitative approach. We would also like to find ways for boosting student motivation by providing them with different possible incentives. One of the possibilities is establishing closer cooperation with local industries and organisations who, at the same time, might become task/problem providers.

With many questions and doubts still in mind, we are happy to observe that PBL in Mathematics in combination with Team Building and Communication Skills is a learning process that has an end goal - namely the increased ability to 'do things'. Learning on the whole is not only about gaining skill and understanding – moving to action is a necessary element, too. Principles of motivation and rapid decision making often determine whether or not a learner will be able to activate known principles. Simply, PBL is a learning process which allows a student to experience an environment first-hand, in this way giving them reliable knowledge.

Learning and knowledge are found in the diversity of opinions. Learning happens in many different ways. Courses, email, communities, conversations, web search, email lists, reading blogs, etc. Courses are not the primary method of learning. Different approaches and personal skills are needed to learn effectively in today's society. For example, the ability to see connections between fields, ideas, and concepts is a core skill. Decision-making is a learning process itself. (Siemens 2004.)

Connectivism, as the theory of learning based on the premise that knowledge exists in the world rather than in the head of an individual and is accessed through people participating in activities, provides an inspiration for our PBL in Mathematics curricula design.

References

Barrows, H.S. and Tamblyn, R. (1980) *Problem-Based Learning. An Approach to Medical Education.* New York: Springer.

Downes, S. (2007) An Introduction to Connective Knowledge, Hug, Theo (ed.): Media, Knowledge & Education - Exploring new Spaces, Relations and Dynamics in Digital Media Ecologies: proceedings of the International Conference, June 25-26, 2007

Kop, R. and Hill, A. (2008) *Connectivism: Learning theory of the future or vestige of the past?* The International Review of Research in Open and Distance Learning, Vol. 9 No. 3

Pilat, R. (1999) *Nauka o procesach poznawczych*. Warszawa: PWN

Polya, G. (1981) *Mathematical Discovery: On Understanding, Learning and Teaching Problem Solving.* (Combined e.). New York: Wiley

Polya, G. (2004) How to Solve It: A New Aspect of Mathematical Method. Princeton University Press

Siemens, G. (2004) *Connectivism: A Learning Theory for the Digital Age.* http://www.elearnspace.org/Articles/connectivism.htm

Spitzer, M. (2002) *Lernen. Gehirnforschung und die Schule des Lebens.* Spektrum.

Problem based learning in portugal

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Although the roots of Problem Based Learning (PBL) date back to the 1960s, related to medical education in MacMaster University, in Canada, in Portugal there is no explicit movement towards the implementation of this methodology. Despite the existence of a few projects and studies on higher education, particularly in Health Sciences, the advantages and disadvantages of this methodology have been little investigated in our country. However, official documents concerning the Bologna process in higher education and curriculum guidelines for basic and secondary education in Portugal suggest that the learning process should be student centred, based on active methodologies and should promote the development of critical and creative thinking and lifelong learning abilities.

Introduction

The present work is part of a doctoral investigation taking place at Psychology and Educational Sciences Faculty in Coimbra's University in Portugal entitled «Problem based Learning with Information and Communication Technologies' in primary teachers training». The main goal of this investigation is to set up, implement and evaluate a training proposal in Information and Communication Technologies' (ICT) methodologically built on a Problem based Learning approach that can satisfy the needs of primary teachers training on ICT in Portugal. In the context of this investigation, it was considered relevant the achievement of a Portuguese literature revision about PBL, and their contribution to the projection and implementation of this methodology in our country.

The central purpose of this article is to present the contribution of Portuguese research into Problem-based learning, with the main emphasis on studies related to teacher education and the PBL implementation in basic education. Firstly, we describe a review of Portuguese investigations on PBL, based on a literature search in Portuguese universities online databases. This research targeted the following keywords: problem based learning, learning based on problem solving and problem based learning in Portugal. Secondly, these documents (articles and theses) are organised by subject areas and their contents analysed under three headings: main purpose, subjects and results. Finally, an outline summary of the results of Portuguese investigation on PBL is given, which may point out future lines of investigation to support the development and the consistent implementation of this methodology.

Background

Research on human cognitive development from the last decades, has changed our understanding about the nature of learning. The idea that students are constructers of their own knowledge, based on prior knowledge and their learning experiences is now accepted by the pedagogical community in general. That is, learning is seen as a result of cognitive and social interactions and students' experience (Major & Palmer, 2001).

Problem Based Learning is an educational methodology in which complex problems present the context and stimulate student's learning. Delisle (2000), believes that the roots of PBL go back to Celestin Freinet, founder of the modern school movement who advocated the idea of learning through experience. In fact, some of the techniques developed by this author, such as self-assessment, study trips and individual work plans, are part of day-to-day activities in most of our schools. With John Dewey, this idea has developed in the concept of 'learning by doing' based on the premise of knowledge as a social process. Later, Jerome Bruner, known as the father of cognitive psychology, supports the idea of learning through discovery.

As an educational methodology, PBL emerges in the context of medical education, with Howard Barrows at McMaster University in Canada, around 1960. The traditional teaching method of medical schools implied that students had to memorize large amounts of information. However, when students were asked to apply this knowledge in practical situations, they didn't get good results. Barrows considered that a doctor's formation should include three interdependent components: knowledge, ability to use knowledge and the ability to extend this knowledge (Delisle 2000). Thus, this institution has developed a curriculum in medical education entirely based on PBL, which quickly spread to other medical schools around the world. Later, this methodology was adopted and applied in different areas and different levels of education.

Relevance

In general, research on PBL leads us to positive outcomes related to learning concepts, development of collaborative work skills, the development of critical thinking and problem solving skills, as well as the increase of motivation and student's responsibility (Major & Palmer, 2001). Portugal is not a country with a long tradition on curricular innovation and pedagogy. However, over time, we found echoes of the great educational movements in history, in the government educational guidelines and in teachers' practices. Currently, the research in pedagogy and didactics, has been developing in a very positively way because of the constant publication of works by Portuguese universities. Thus, we can say that we are starting to have in Portugal, a body of knowledge resulting from research, that allows us to characterize the teaching and learning process in our country.

The origin of the PBL in our country is taking a similar path that other educational approaches had. PBL, primarily, arises in the medical community and, later, spreads to other areas of knowledge. The first work on PBL found in Portugal, leads us to the Course of Medicine, in New University of Lisbon, between 1987 and 1990, in the discipline of physiopathology. Rendas et al (1993) present a project of integration of a PBL discipline in a traditional medicine course. This first project opened the way for PBL's implementation in Portugal although, as stated by Rendas (2010), the subject is still controversial. Nowadays, the Universities of Minho, Beira Interior, Algarve and Aveiro have medical curricula oriented to PBL and there are numerous other ongoing projects to implement this methodology in other schools all over the country.

Our laws for the educative system stipulate, in its 2nd Article, that the educational system should promote the full and harmonious development of individuals, encouraging the formation of free, responsible, autonomous and supportive citizens. This document also states that education should promote open dialogue and free exchange of opinions, as well as critical and creative thinking development. In Article 7, is further stated that education should enable the development of methods and tools for personal and group work, emphasizing the human dimension of work. Curriculum guidelines and programs of the various levels of education in Portugal include the reference to active, student-centered learning experiences, to promote the development of critical thinking skills, problem solving and lifelong learning.

In basic education, the learning standards suggest that the mobilization of knowledge should be made in an inter-related way, for instance, a given situation or problem. Also, in higher education, the Bologna declaration has brought some changes in order to standardize higher education in Europe. The publication of the law number 49/2005, of August 30th, provides the form of transition from an education system based on knowledge transmission to a system based on skills development. Accordingly, the

law number 74/2006, of March 24th, states that graduates must demonstrate problem solving skills within their areas of training.

Concurrently with the foregoing, it is considered that PBL is a possible methodology on the Portuguese context, in the different levels of education which corresponds to the government orientations and is consistent with current knowledge on learning. It will be important, in this respect, to draw a general picture of research already performed in this field in our country to form a documental base that enables us to outline paths for the future.

Focus

The present study aimed to characterize the investigations carried out by Portuguese authors on projects of PBL's implementation in Portugal.

For this purpose, we intend to build a matrix of what has been done in Portugal on PBL that can: a) clarify its effectiveness in the Portuguese context, b) summarize scattered information on the methodology; c) set out guidelines for future research and investigation on PBL in Portugal.

Methods

The current study is a descriptive and interpretative study, based on content analysis technique. According to Bardin (2004), content analysis is defined by several authors as a research technique that through an objective, systematic and quantitative description of the content of communications, that allows us the interpretation of such communications.

Since the objective of this study was to undertake a synthesis of results from previous studies, we have adopted the following steps: defining the goals of analysis, constitution of documental base of research, encoding the characteristics of the works, organization and interpretation of results (Coutinho, 2008).

The analysis of the documents aimed the definition of trends and common points in the works written about PBL in Portugal. For the definition of the variables to analyze we tried to take into account the specificities of the documents in question. Initially we considered the following variables: year of publication, study area, type of publication, the host institution of the project, goals, and lastly, the conclusions. Throughout the analysis, it was necessary to include the variables "techniques and tools', 'level of education', and 'type of project'. This need has arisen because we found a common trend along the documents in some of these characteristics.

Constitution of the documental base

For the purpose of the constitution of the documental base, a general nature research was conducted on an Internet search engine. This research had the following keywords: «problem-based learning», «learning based on problem solving» and «problem-based learning in Portugal». As a result of this research, we found that most of the papers presented were available in databases of institutions of higher education. Thus, we conducted a research in the online databases of the main Portuguese universities and schools of higher education. Although some studies have related the use of similar methodologies or the use of PBL but without an explicit link with the theory, these were not considered for this study.

For analysis in this study were considered sixty-three documents available in the online databases mentioned above. The references of the analyzed studies were not included in this article because it would be too extended. Based on the identification of the documents, a content analysis was performed in the variables mentioned above to identify the existence of any trends. Given the time difficulty of reading and analyzing sixty-three studies (among these, Master's and PhD theses), we chose to focus the analysis on three elements: abstracts, methodology and conclusions. When we could not find the necessary information, this was sought in other sections of the documents.

After the selection of the documents to analyze, these were organized according to the author/authors and date of publication. To facilitate the identification of the documents, each one was assigned with a code representing the name(s) of author(s) and date of publication. For example, the work of Rendas in 1993 was coded like Rendas et al. in 1993.

The documents from the documental base (63) were analyzed and the following variables were defined and related categories and sub-categories.

Board 1. Variables, categories e subcategories of analyses

Variables	Categories	Subcategories	
Year of publication			
a) Study area	- Economy - Education - Engineering - Health - Psychology		
b) Type of publication	- Articles	- Congresses	- Nationals - Internationals
		- Journals	- Nationals - Internationals
	- Books		
	- Reports		
	- Theses	- Course - Master - Doctoral	
c) Hosting Institutions	- Universidade do Minho - Universidade de Coimbra - Universidade Nova de Lisboa - Universidade de Lisboa - Universidade de Aveiro - Universidade do Porto - Universidade da Beira Interior - Universidade de Trás-os-Montes e Alto Douro - Universidade Lusófona - Universidade Católica - Instituto Superior de Engenharia de Coimbra - Instituto Superior de Engenharia de Lisboa - Instituto Politécnico de Bragança - Instituto Piaget - Escola Superior de Enfermagem de Coimbra - Escola Superior de Tecnologias da Saúde de Coimbra - Escola Superior de Tecnologias da Saúde do Porto - Other Editors		
d) Level of teaching	- Basic Education - Secondary Education - Higher Education		

e) Purpose of investigation (with this investigation we aimed to understand the influence of PBL in...)	- Books and official document - Cognitive skills - Experiences - ICT skills - Motivation/attitudes - Opinions - Results - Teaching materials - Transversal skills
f) Techniques and instruments	- Interviews - Questionnaires - Scales - Testes - Direct observation - Reports - Content analyses
g) Conclusions (implementation of PBL shown improvement in…)	- Results - Motivation - Social skills - Knowledge - Critical thinking - Autonomy - Self knowledge - Questioning abilities - Professional development - Responsibility - Communication skills

The first aspect to consider in the document analysis was to understand how the publication of papers on PBL evolved over the years, the date of first publication, and what the most recent references are.

Presentation the results

The documents considered for this study were published between 1993 and 2012. There is a steady increase in the publication of papers on PBL in Portugal since the first publications. Although some variations were observed, after the year of 2005 there was a greater trend of growth. The year of 2012 must not be considered in this study, since the studies included were published online in the first quarter of the year. For that we can not anticipate the total number of papers in the next quarters. It is worth noting the percentage of papers published in 2011 (22.2%).

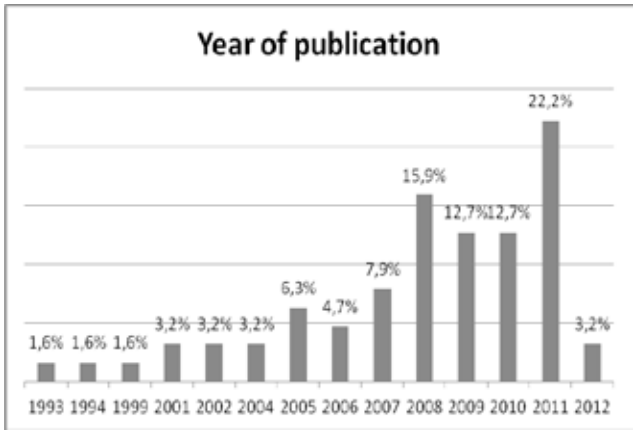

Chart 1. Distribuition of works for year of publication

Table 1. Distribuition of works for year of publication

Year of publication	Frequency	
1993	1	1,6%
1994	1	1,6%
1999	1	1,6%
2001	2	3,2%
2002	2	3,2%
2004	2	3,2%
2005	4	6,3%
2006	3	4,7%
2007	5	7,9%
2008	10	15,9%
2009	8	12,7%
2010	8	12,7%
2011	14	22,2%
2012	2	3,2%

Within this study, it was considered essential to understand the area in which the projects had been implemented. Thus, the works were organized according to the variable b), study area. This variable considered the following categories: economy, education, engineering, psychology and health.

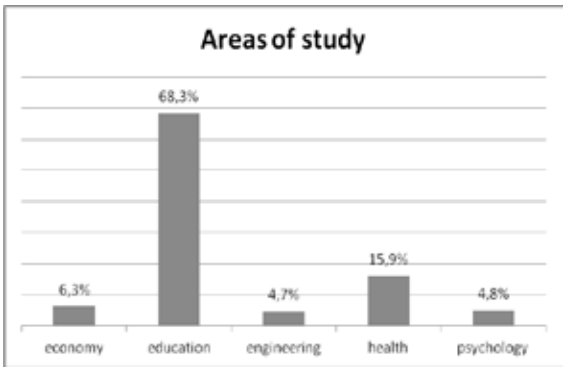

Chart 2. Number of works for area of study

Area of study	Frequency	
economy	4	6,3%
education	43	68,3%
engineering	3	4,7%
health	10	15,9%
psychology	3	4,8%

Table 2. Number of works for area of study

Although the first studies found refer to the area of health, the area with the highest number of publications on PBL is education with 68.3% of the results. Next is the area of health with 15.9% of the published works. The area of psychology had 4.8%, engineering 4.7% and economics 6.3% of the assessed work.

Then, it was considered important to organize the work by type of publication. Thus, we studied the following categories: articles, books, reports and theses/dissertations.

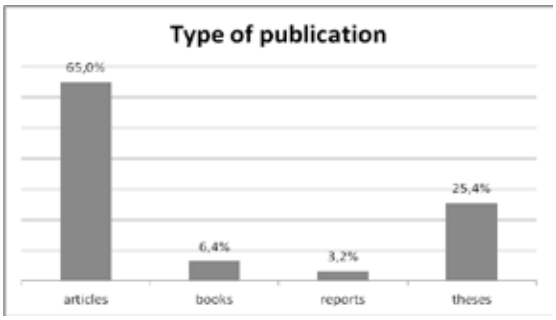

Chart 3. Number of works for type of publication

Type of publication	Frequency	
articles	41	65,0%
books	4	6,4%
reports	2	3,2%
theses	16	25,4%

Table 3. Number of works for type of publication

The most common type of publication on PBL are articles (65%). The theses also have some relevance (25.4%). It should be noted that in the process of constitution of the documental base, some articles were found that matched with the works presented on theses, converted in communications for conferences. These articles and texts have been counted twice, on the one hand because the articles often exhibit only a part of the investigation and on the other hand, it was considered important to research on the type of articles on PBL.

Thus, with respect to articles, it was possible to distinguish the following subcategories: articles published in national journals; articles published in international journals; articles published in proceedings of national conferences; and articles published in proceedings of international conferences.

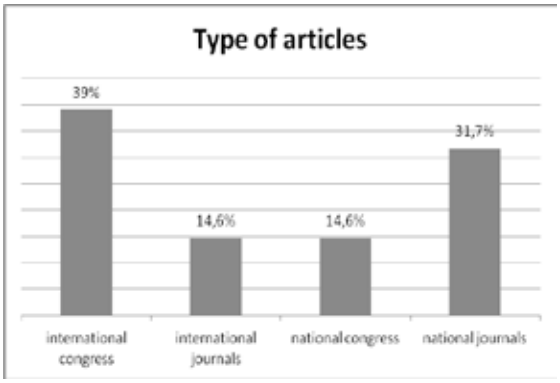

Chart 4. Number of works for type of articles

Type of articles	Frequency	
international congress	16	39%
international journals	6	14,6%
national congress	6	14,6%
national journals	13	31,7%

Table 4. Number of works for type of articles

Most articles published correspond to communications in international congresses (39%). The articles published in national journals have a representation of 31.7% of the works. The articles related to national conferences and articles published in international journals come with 14.6% of the works, each.

In what concerns theses/dissertations, these are distributed differently in the degrees of education. Thus, we considered the following subcategories: course theses, master's theses and doctoral dissertations. Most studies found in this category correspond to master's theses (80%).

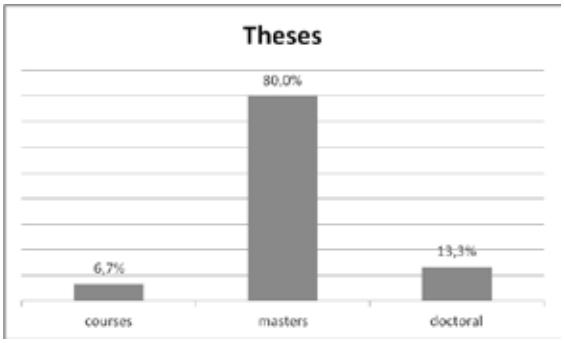

Chart 5. Number of works for type of theses

Theses	Frequency	
courses	1	6,7%
masters	12	80,0%
doctoral	2	13,3%

Table 5. Number of works for type of theses

Most analyzed publications were related to Universities, Colleges and Institutes of Higher Education. To this end, we considered the institutions of the authors of the work. Books (4) were included in the category „other publishers" because these are most of the times written by various authors from different institutions. This category also included a journal of a Luso-American Foundation, whose opinion piece didn't allow us to establish a connection to an institution of higher education.

Board 2. Number of works for Insitution of higher education

Escola Superior de Enfermagem de Coimbra	1
Escola Superior de Tecnologias da Saúde de Coimbra	2
Escola Superior de Tecnologias da Saúde do Porto	2
Instituto Piaget	1
Instituto Politécnico de Bragança	2
Instituto Superior de Engenharia de Coimbra	1
Instituto Superior de Engenharia de Lisboa	1
Other editors	5
Universidade Católica	1
Universidade Coimbra	4
Universidade da Beira Interior	1
Universidade de Aveiro	6
Universidade de Lisboa	3
Universidade de Trás-os-Montes e Alto Douro	1
Universidade do Porto	4
Universidade Lusófona	1
Universidade Minho	24
Universidade Nova de Lisboa	3

In the analysis of the papers' goals two categories were considered according to whether they were a theoretical literature review or the presentation of a practical implementation of the methodology. Most analyzed works were PBL implementation projects (58) and only five (5) were reviews of the literature.

In the group of studies that presented practical implementations of PBL all levels of education were represented, from basic to higher education. The level of education with the largest number of works is higher education (48%), followed by basic education (43.1%).

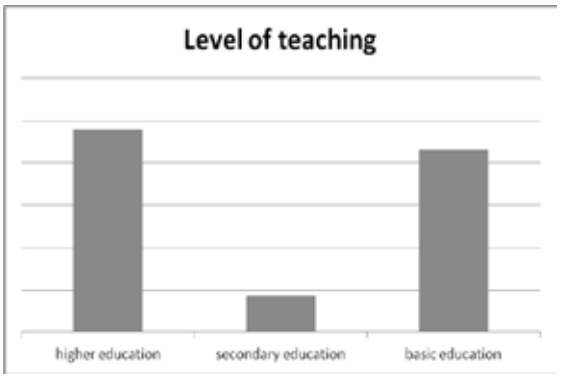

Chart 6. Number of works for level of of education

Level of teaching	Frequency	
higher education	28	48%
secondary education	5	8,6%
basic education	25	43,1%

Table 6. Number of works for level education

In the group of studies that presented the implementation of PBL projects, the variable f) research objectives was analyzed. For this variable, the following categories were considered: books and official document; cognitive skills; experiences; ICT skills; motivation/attitudes; opinions; results; teaching materials. In the analysis of this variable sixty-nine entries were considered in total because some works have presented more than one research objective.

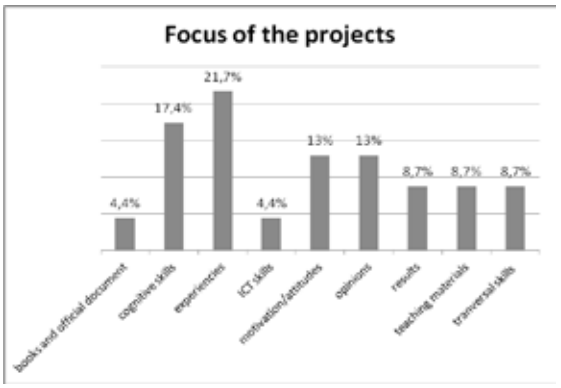

Chart 7. Focus of the projects

Focus	Frequency	
books and official document	3	4,4%
cognitive skills	12	17,4%
experiences	15	21,7%
ICT skills	3	4,4%
motivation/ attitudes	9	13%
opinions	9	13%
results	6	8,7%
teaching materials	6	8,7%
transversal skills	6	8,7%

Table 7. Focus of the projects

As far as variables g) 'tools and techniques' and h) 'results' are concerned, it wasn't always possible to accurately define these data in each of the studies reviewed, since some documents only had their summaries available and it wasn't possible to access the complete work. For this reason, only forty-four works were analyzed in the variables 'tools and techniques' and 'results'.

The variable g) techniques and instruments, was analyzed according to the categories: interviews; questionnaires; scales; testes; direct observation; reports; and content analysis. Most of the studies reviewed used different techniques and instruments for data collection, as recommended in the literature, in order to achieve data triangulation.

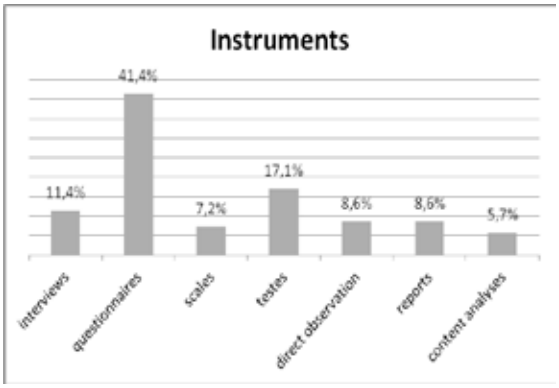

Chart 8. Instruments used for data collection

Instruments	Frequency	
interviews	8	11,4%
questionnaires	29	41,4%
scales	5	7,2%
testes	12	17,1%
direct observation	6	8,6%
reports	6	8,6%
content analyses	4	5,7%

Table 8. Instruments used for data collection

The most commonly instruments used are questionnaires (41.4%) and tests (17.1%).

Finally, we proceeded to the analysis of variable h), which relates to conclusions. The analysis revealed the following categories of evidence after the implementation of PBL: improvement in the results; increase in motivation; development of social skills; acquisition of knowledge; development of critical thinking; improvement in autonomy; development of self-knowledge; development of questioning abilities; professional development; and increase of students' responsibility.

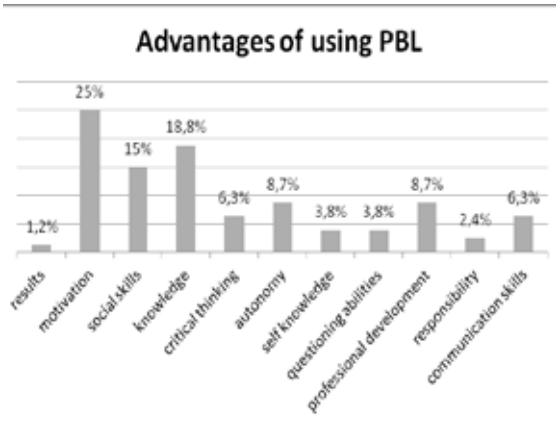

Chart 9. Advnatages of using PBL

Advantages	Frequency	
results	1	1,2%
motivation	20	25%
social skills	12	15%
knowledge	15	18,8%
critical thinking	5	6,3%
autonomy	7	8,7%
self-knowledge	3	3,8%
questioning abilities	3	3,8%
professional development	7	8,7%
responsibility	2	2,4%
communication skills	5	6,3%

Table 9. Advantages of using PBL

The results mentioned more often in the analyzed studies are linked to the increase of motivation (25%), the acquisition of knowledge (18.8%) and the development of social skills (15%). It should be noted some negative aspects, mentioned in the analyzed works, as a result of PBL implementation.

One of the issues raised was the difficulty experienced by tutors in integrating a new methodology. It was referred the importance of the interrelationship between the areas of Educational Sciences and Medicine, to prepare teachers of higher education to use the methodology. From the perspective of students, a methodological change is not always welcome and causes some concern.

One of the issues also felt by the participants in these projects is the change in the role of teacher and student. One of the studies reported as a negative aspect related to the implementation of PBL, was an increase in the time of preparation of activities for teachers and an increase in the autonomous work to be undertaken by students. Other less positive references are the difficulties associated with the students' evaluation process. In this regard we can mention the work of Major and Palmer (2001) which state that the assessment must follow the methodological changes to meet the requirements of this form of learning.

Conclusions

One of the objectives of this study was to find common points in the works published about PBL in Portugal. Like reported in other countries, PBL first appeared in Portugal in medical schools and proliferated to other areas of study in higher education. Finally, it was adopted in other levels of education. The study area mainly represented in the analyzed studies is education. This is understandable since it is a teaching method, and, therefore, belongs to the field of education. The significant representation of health is related to the origin of PBL in medical schools.

The number of studies published per year in the area of the PBL has been growing. There was only one break between 2005 and 2006. This increase is probably due to the increasing importance given to the publication of research in education, increasing number of masters (which is also reflected in the number of works that represent theses/dissertations) and doctors in general in the country and changes in the rules for career development of university professors and school teachers, which contemplates academic publishing for professional development. We have to relate also the increase in the number of articles published about PBL with the Internet's evolution and the creation of Universities and Schools of Higher Education online databases for which we accessed to make this work and, without whom this study would be impossible.

Regarding the type of publications found, articles and theses have greater preponderance among them. Articles representing communications in international congresses are in greater number, which might indicate that the educational community in Portugal is attentive to what is happening in other countries and eager for knowledge. With respect to the host institutions of the works, the University of Minho appears prominently in the publication of works in this area. This high number of publications seems concomitant with the development and projection that this university has had in education, both nationally and internationally.

The levels of education with more projects published on PBL are higher education and basic education. This prevalence is probably related to the number of years that each level represents. Basic education covers five years, secondary education consists of three years and higher education, three to five years. Thus, there are least opportunities in secondary education for developing projects with a new methodology in a continuous and consistent way. Within the objectives of the studies analyzed we can conclude that the majority focuses on the description of experiences and students' learning. There is also a representative number of studies whose goal is to understand the views of students and teachers about PBL and its influence on motivation and attitudes towards education.

In the conclusions presented by the studies analyzed, the results more often observed through the implementation of PBL are students' motivation, learning and the development of social skills. In general, in conjunction with other studies, PBL presents itself as a methodology applicable in teacher education in Portugal as well as in other areas of study, namely because of its impact on the motivation and students learning.

The main goal of this study was to present a summary of the main PBL publication in Portugal available on the Internet, more precisely, in the institutions of higher education databases. Thus, we believe that there may be other reports or projects whose findings have never been a target of scientific reflection and therefore represent specific experiences, localized in time and space but, unfortunately, they don't contribute to the construction of knowledge about PBL. There are also some projects which we have heard about but, for economic reasons and time management, it was not possible to describe in detail. In particular, the implementation of courses in Health Sciences, in the Universities of Algarve and Aveiro and two projects funded by the Science and Technology Foundation entitled "Problem based learning in higher education", developed at the University of Lisbon, and "Science Education for Citizenship through Learning based on problem solving", developed at the University of Minho.

On one hand, in the context of this study documental base, we consider important to investigate in a more comprehensive way, which an article of this nature does not allow, the relationship between the authors referred in various works and compare

the literature reviews presented in master's and doctoral theses/dissertations. On the other hand, it is important to try to understand the methodology used in each work and how this methodology is suitable to the study of PBL. Another objective of this study was to establish guidelines for future research that promote the development and implementation of this methodology in Portugal.

Many of the studies reviewed agree on the need for more studies investigating the effect of PBL on students' learning. In fact, in our research we found only one study whose main objective was to investigate the influence of PBL on students' outcomes. In addition, more comprehensive studies are needed to conclude about the advantages of PBL in the different levels of education. In education, in regard to initial teachers training, some authors refer to the importance of studying the effects of using this methodology in the teaching practices of future teachers. During this study, there were few works on the use of ICT as privileged forms of implementation PBL. This may also be a path with high expectations for future investigations so that technology plays an increasingly important role in education.

References

Bardin, L. (2004). Análise de Conteúdo. Lisboa: Edições 70.

Coutinho, C. (2008). Web 2.0: uma revisão integrativa de estudos e investigações In Carvalho, A. (org.). Actas do Encontro sobre Web 2.0, Braga: CIEd, 72-87.

Delisle, R. (2000). Como realizar a Aprendizagem Baseada em Problemas (Colecção Cadernos do CRIAP). Porto: Edições Asa.

Major, C. H.; Palmer, B. (2001). Assessing the effectiveness of Problem based learning in higher education: lessons from the literature In Academic Exchange Quarterly, 5 (1).

Rendas, A. (2010). A Aprendizagem Baseada em Problemas (Problem-Based Learning) Aplicada à Educação Médica: O Que Ficou Vinte Anos Depois? In Depoimentos 25 anos da Fundação Luso-Americana 1985-2010, 23-26.

Rendas, A.; Ferreira, G.; Fradique, A.; Gamboa, T.; Carmo, M.; Neuparth, N.; Pereira, C.; Ramalho, V.; Ribeiro, I.; Botelho, M. (1993). Aplicação do Método de Aprendizagem Baseada em Problemas ao Ensino da Fisiopatologia In Educação Médica vol. 2, n.º 2, Lisboa, pp. 29-40.

Competences of the employees at lithuanian tourism enterprises: how to develop them

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Recognizing that competent people are the key to the organization's future success as well as the background to its competitive advantage, companies are looking for professional employees and are ready to invest into the development of the existing ones. Traditional approach to teaching and learning in the higher education institutions is very often isolated from the realities of the surrounding world and not powerful enough in relation to personality development. This mode of teaching hardly reflects activities the graduate will be involved in after leaving university. Traditional approach to teaching and learning is only imitation.

The tourism sector is one of the leading economic sectors in many countries. Its activities represent the country in the world, create an attractive image of it and stand out for high labour intensity. Tourism in Lithuania is identified as a priority industry. However, when capturing a significant development of tourism infrastructure in Lithuania, the shortage of qualified professionals who are able to create and develop high quality and internationally competitive product is observed.

The aim of this article is to discuss the key competences of employees at Lithuanian tourism enterprises and advantages of PBL (Problem Based Learning) when developing them.

PBL and its implementation process

Compared to traditional teaching and learning, PBL provides freedom to students as well as emancipates and releases them from authorities. Students contribute to the formulation of the problem: nobody knows in advance what the final decision should be like. Working in groups, students may find diverse solutions which all can be right. PBL is supported by the principles of constructivism, which point out that knowledge cannot be objective, that it is created through cooperation and discussion taking part during the study process (Gordon 2009). The role of teaching staff in PBL is very important and very different from the traditional one: a teacher has to shift from the position of a sage to the position of a supporter.

One of the roles of higher education is to prepare people for lifelong learning. This is the main reason why it cannot focus only on transfer of knowledge which is getting 'old' very quickly but has to pay attention to the development of core skills. The PBL takes place within the unforeseen context where the final result cannot be known in advance, which is very similar to real life situations. Finding solutions to problems is not the main aspect of PBL; much more important is to provide possibilities for learning with motivation and interest (Savin-Baden 2000).

PBL is one of the most powerful ways for those looking for meaningful studies. One of the key components of meaningful studies in PBL is integration of new knowledge into already existing system of it (Fyrenius, Bergdahl & Silen 2005). It (PBL) is kind of illustration how learning correlates with the human life not ignoring previous experience but depending and building on it. A very important part of PBL is identification of prior knowledge (as well as the knowledge 'gaps' in order to fill them in) and experience which are used for solving new problems and result in better and deeper understanding.

PBL is the background for students' independence. Learning takes place through the expression of personal position as well as through the reflection on learning results. Students have the right to express their opinion and even to confront other opinions.

PBL happens through the group discussions and meetings with the tutor who at the same time is also an equal member of the group. The shift from teacher to student centred learning creates opportunities for the student's initiative and freedom. PBL provides wide opportunities of choice starting with the problem to be analyzed and finishing with the information sources to be used.

All benefits which problem-based learning pedagogy brings into the study process as well as the research findings on key elements of the managerial competency

encouraged the community of Business Management Faculty at Kauno Kolegija University of Applied Sciences to develop a more integrated curriculum based on PBL philosophy.

Managerial competency is thought to be of the key importance for business enterprises. It is a set of knowledge and skills as well as the ability to apply them in real situations. It is completion of managerial functions depending on restrictions of situation and environment (Kasiulis & Barvydienė 2003). Complexity of scientific approach to personal managerial competency explains the lack of its clear structure. Multifaceted structure of managerial competency is described by scientists' approach to management process, management skills and functions of managers within organizations.

Banyte, Gadeikiene & Kuvykaite (2006) identify the following constituent parts of managerial competency: 1) technical competence, which is the scope of practical skills and knowledge needed for performance of technical tasks clearly defined by the specifics of job; 2) communicational competence, which is seen as the scope of personal characteristics and communication skills. Dawson, Messenger & Williams (1998) divide managerial competency into personal and professional parts, at the same time emphasizing their interdependence. It is true that personal qualities very often help to make right decisions in specific professional situations; that is why it is possible to emphasize the importance of both groups of competences for effective management.

The concept of three groups of management skills, according to which managerial competency is divided into conceptual, communicational and technical skills has caught the interest of scientists (Stoner, Freeman & Gilbert 1995).

- *Technical skills* cover personal knowledge and ability to use specific equipment and technologies. These skills are especially important for the middle level managers. Climbing to the top of the management hierarchy, the need for them is declining.
- *Skills of working with people (communicational skills)* cover the ability to work with people and to organize group activities. These skills are seen as the most important management skills.
- *Conceptual skills* are expressed by systemic thinking, ability to model and holistic approach to environment and events. The higher the position of a manager, the more important these skills become.

Structural elements of the competency are interdependent and influence each other: it is a must to have the whole set of them. It is worth to point out that importance of each element of the competence depends very much on the specifics of the service

provided as well as the concept of service provision. This is why it is possible to analyze and generalize the key elements of some service area only after defining the specifics of that area as well as the set of necessary characteristics of employees and relative importance of competency elements. The research of competences of employees in Lithuanian tourism enterprises was based on (Stoner & al. 1995) structural classification of competences.

Methodology

The misbalance between increasing numbers of work places in tourism sector caused by the development of tourism infrastructure and the supply of competent personnel is currently observed in Lithuania. This situation has led to a sociological study with the aim to explore:

- the importance as well as the structure of competences of employees working in tourism sector;
- the mastery level as well as development forms of competences of the employees working in tourism sector enterprises.

Lithuanian tourism sector enterprises for this research were selected by using the quota and random sampling (N = 477). Quotas have been set according to the tourism business activity (219 accommodation providers, 105 travel agencies, 42 tourist information centres (TIC), and 111 rural tourism businesses). The survey was carried out by applying face to face interview built on questionnaire prepared for tourism business senior and middle level managers. Seeking to identify the importance of survey indicators to respondents, Likert scale was used (where 1 stands for 'not important', and 5 for 'very important'). Likert scale, which is built on sequential ranking of statements, was chosen as a valid instrument for evaluation of opinions/positions (Arnold, McCroskey, & Prichard 1967).

For carrying out a sociological study, competences of tourism sector employees – research indicators – have been identified and clustered building on the concept of three groups of management skills (Stoner & al. 1995) (Table 1).

Table 1. Competence structure of tourism sector employees

Technical competences	• Foreign languages; • Information management skills; • Understanding own and other cultures and traditions; • Ability to adopt existing/develop new product which meets the client's needs; • Ability to work on international level; • Knowledge of history and facts.
Competences of working with people (communicational competences)	• Conflict management skills; • Interpersonal skills; • Organizational and planning skills; • Tolerance to criticism; • Cultural, racial and other tolerance; • Ability to work in multidisciplinary teams; • Ability to establish and maintain contacts with professionals from other fields.
Conceptual competences	• Ability to observe general moral principles; • Ability to adapt to new situations; • Responsibility for decisions made; • Giving priority to quality; • Quick response to changes when making decisions; • Problem solving skills; • Entrepreneurial skills and initiative; • Ability to generate new ideas, initiation of progressive changes; • Ability to evaluate risk and suggestions as well as to foresee consequences; • Ability to analyze, generalize and forecast business changes and trends; • Long term strategic thinking; • Ability to combine and apply complex activities related to management within international tourism industry.

Results of this sociological study reflect the overall opinion of managers of Lithuanian tourism sector enterprises because the error of calculation does not exceed 4.1% (spread of all responses).

Research findings and their analysis

Almost half of the companies involved in the survey (47%) indicated that they employ 1-2 of tourism professionals. A quarter of enterprises (23%) had 3-5 experts in this field, one fifth (19%) - 6 or more specialists in this area. Travel agencies employed the highest average number of tourism professionals (8 experts); fewer of them worked in tourist information centres and rural tourism enterprises (3 specialists in average). The average number of tourism professionals per company is 5 employees, which suggests that the tourism sector employs people whose education does not meet the needs of skills and qualifications identified as the most important in this sector.

Although more than half (53%) of employees in tourism sector have a university degree, one fifth (19%) possesses a non-university higher education qualification, 12% of

them still study at the university, only 27% of the employees have completed special studies in the field of tourism. In average, 62% of the employees in the field of tourism have not completed any special tourism management studies, while 11% are still studying and seeking to become qualified specialists in this field. These results show that the majority of Lithuanian tourism sector employees do not have field related qualification; necessary skills are acquired during practical activities.

Work conditions are influenced by the processes of economic and social globalization. Radical changes occurring in work situations influence both the structural changes within the field of activity and changes of occupation related competences. The research was focused on finding out the key competences needed for a specialist working in the field of tourism (see Table 2).

Table 2. Evaluation of importance of competences

Skills	Competences	Importance of competence, points
Technical competences	• Foreign languages; • Information management skills; • Understanding of own and other cultures and traditions; • Ability to adapt existing/develop a new product which meets the client's needs; • Ability to work on international level; • Knowledge of history and facts.	4.8 4.7 4.6 4.5 4.4 4.1
Competences of working with people (communicational competences)	• Conflict management skills; • Interpersonal skills; • Organizational and planning skills; • Tolerance to criticism; • Cultural, racial and other tolerance; • Ability to work in multidisciplinary teams; • Ability to establish and maintain contacts with professionals from other fields.	4.8 4.8 4.8 4.7 4.7 4.5 4.4
Conceptual competences	• Ability to observe general moral principles; • Ability to adapt to new situations; • Responsibility for decisions made; • Giving priority to quality; • Quick response to changes when making decisions; • Problem solving skills; • Entrepreneurial skills and initiative; • Ability to generate new ideas, initiation of progressive changes; • Ability to evaluate risk and suggestions as well as foresee consequences; • Ability to analyze, generalize and forecast business changes and trends; • Long term strategic thinking; • Ability to combine and apply complex activities related to management within international tourism industry.	4.9 4.9 4.9 4.8 4.7 4.7 4.7 4.7 4.6 4.6 4.5 4.2

The ability to observe general moral principles, politeness, responsibility for the decisions made, giving preference to quality (average evaluation score 4.9 out of 5) have been identified as the key competences. Thus, the elements of conceptual competence group within managerial competency have been identified as the most important by the respondents. Such skills within the communicational competence as conflict management, interpersonal skills, planning and organizational skills scored 4.8 points. What is striking is the attitude of the respondents towards ability to combine and apply the complex factors associated with management activities on the international level. Recognizing international nature of the tourism sector enterprises, this competence must be seen as one of the essential ones when seeking for competitiveness of the tourism product in the international markets.

Competences within technical group have been seen as having different importance by respondents; the average score varies in between 4.1 to 4.8. Similarly, the evaluation of competences assigned to the group of conceptual skills varies from 4.2 to 4.9 points. Such differentiation of evaluations can be explained by the multisectorality of tourism industry. The results of this sociological survey show that in the various tourism sector enterprises - accommodation, tourist information, and rural tourism - the importance and priority of skills is different (see Fig. 1).

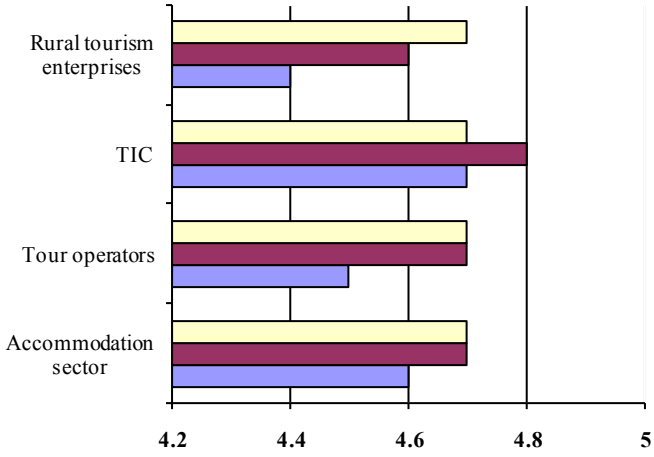

Figure 1. Evaluation of selected competences in tourism sector enterprises

Different priorities and importance of competences are related to the specificity of tourism enterprises. High interaction level between service provider and user is the key reason why the elements of communicative competence are seen as the most important. But evaluation of competences within this group also differs depending on functional activities of companies: average score for TIC (tourism Information Centres) is 4.8 points, for tour operators and accommodation sector enterprises – 4.7

points. Conceptual skills are assessed as equally important by all tourism sector enterprises (average score – 4.7)

Analysis of skills within communicational competence reveals the difference in evaluations within the group. Conflict management is seen as the most important skill for accommodation sector enterprises, whilst TICs emphasize interpersonal as well as planning and organizational skills. Basing on respondents' preferences granted to the individual groups of competences, it is possible to provide a hypothetical structure of the competences for different tourism sector enterprises (see Fig. 2).

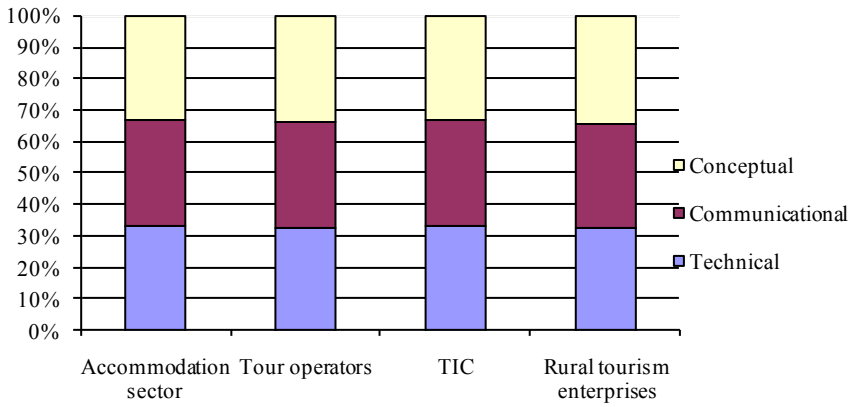

Figure 2. Hypothetical structure of competences

Tourism product is the sum of various subject related and functional parts of the supply, which very often are created by different manufacturers, i.e. tourism product is formed by individual structural elements of the tourism industry. Therefore, seeking for high quality of tourism services, assessing the dynamics of and changes in consumer behaviour as well as different consumer needs, it is necessary to balance and coordinate different parts of the tourism sector activities. Compatibility of competence framework of tourism sector employees is the assumption for high-quality tourism services. The hypothetical structure of competences provided in Figure 2 suggests that Lithuanian tourism sector enterprises have recognized the need to strive for uniform competences both at structural and mastery-levels.

Conclusions

In summary, it is important to point out that with the increase of competition as well as the willingness to meet the dynamic and heterogeneous tourism service users' needs, the competency of employees is becoming an important competitive advantage for service organizations.

Building on the concept of three groups of management skills and research findings, it is possible to claim that employees of Lithuanian tourism sector enterprises are the strongest in the area of communicational competences, but as the most important ones they see conceptual competences. The received results lead to the conclusion, that managers of tourism sector enterprises understand an exceptional importance of personnel qualification, which is conditioned at least by two reasons: (1) from the consumer's position, employees are the service itself, and (2) they (employees) directly influence most of the quality dimensions.

Recognition of the importance of competences within conceptual group (4.7) suggests that the managers of Lithuanian tourism companies understand the need for competences that precondition operations in the international markets together with other players of service delivery system, help to assess risk and adapt to new situations, initiate innovative changes at the same time foreseeing potential consequences.

Having agreed that compared to traditional teaching and learning PBL provides freedom to students as well as emancipates and releases them from authorities, it is possible to state that it (PBL) is the best way for developing conceptual competences listed and discussed above. By presenting the students with real life situations, PBL gives possibility to practice problem solving skills and acquire knowledge in a more motivating and exciting way.

PBL is a student-centred learning which requires a great deal of coaching, help and encouragement when adapting to this new methodology which results in deeper understanding and better prepared professionals. Hypothetical structure of employees' competences helps to reveal the need for harmonized framework of competences.

Awareness of the competence structure is very important when planning and organizing staff development. The importance of competence development is conditioned by disorders of tourism sector activities associated with the specificity of tourism services, the variety of services, the spread of service locations, abundance and diversity of partners.

When approaching the employee as the part of supply of the service organization and comparing the investment in staff to the investment in the service improve-

ment as well as recognizing that the service life cycle constantly becomes shorter and the number of innovations increases proportionally to technological progress, staff development should be a permanent concern of organization and of every single employee.

References

Arnold, W.E., McCroskey, J.C., Prichard, S.V.O. 1967. The Likert-type scale, Today's Speech, 15, p. 31-33.

Banyte, J., Gadeikiene, A. & Kuvykaite, R. 2006. Peculiarities of Human Resources Management in a Service Enterprise, Engineering economics, No. 2 (47).

Dawson, J., Messenger,, S. & Williams Ch. 1998. Developing competence in retailing: strategic advantages, Journal of Retailing and Consumer Services, Vol. 5, No. 4, p. 235-244.

Fyrenius, A., Bergdahl, B. & Silen, C. 2005. Lectures in problem-based learning - Why, when and how? An example of interactive lecturing that stimulates meaningful learning, Medical teacher.

Gordon, M. 2009. Toward a pragmatic discourse of constructivism: reflections on lessons from practice, Educational studies.

Kasiulis, J. & Barvydienė, V. 2003. Vadovavimo psichologija, Kaunas: Technologija.

Savin-Baden, M. 2000. Problem-based learning in higher education: untold stories, Buckingham: Open University Press.

Stoner, J.A.F, Freeman, R. E. & Gilbert, D.R. 1995. Management (6th ed.), Englewood Cliffs, NJ: Prentice Hall.

This book is a collection of papers from the International Conference on Problem-Based Learning 12th-13th April 2012 organized by the Rovaniemi University of Applied Sciences, Finland. The conference was arranged in cooperation with the Finnish Society for Problem-Based Learning, ProBell, and the University of Lapland. The event gathered about 100 participants from 10 different countries.

For over ten years ProBell (www.probell.fi) has organized annually a conference or a seminar in Tampere, Hämeenlinna and Lahti in the Southern Finland. This year the latest research on Problem-Based Learning (PBL) was presented for the first time in Rovaniemi on the Arctic Circle, which is also home to Santa Claus in Lapland

The themes of the conference, as well as the articles of the book, included several interesting aspect on PBL: *Work and Learning, Entrepreneurial Education, Networks and Learning, Learning Spaces and Environments and Identity and Learning.*

The book is aimed at teachers and researchers from a variety of disciplines, as well as developers, trainers and experts on working life interested in pedagogical development of their practices. The book examines PBL across a range of subjects including economics, education and teacher training, environmental technology, health sciences, human resource management and mathematics.

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