Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page I-IV

Fifth Issue of the Journal of Problem Based Learning in Higher Education

*Thomas Ryberg, Jacob Davidsen, Bettina Dahl **

INTRODUCTION TO THE FIFTH ISSUE

We are pleased to introduce the fifth issue of the Journal of Problem Based Learning in Higher Education. The current issue is composed of four research papers and four PBL cases. These address different aspects of PBL and feature contributors from The Netherlands, Croatia, Denmark, Ireland, Ukraine, the UK, and Brazil. Three of the papers analyse and reflect on concrete implementations of PBL and particular methods and tools that have been used to support students' work with PBL. The fourth paper reflects on the conditions of knowledge production in Higher Education with point of departure in a particular PBL model. The four cases report and reflect PBL implementations within Engineering, Medical Education and a MBA programme. This brief recap helps to illustrate that PBL is both of international, global interest, but also is becoming adopted within a range of different disciplines.

From a PBL research perspective this is of course exciting and invigorating, but moreso we should say that from a citizen and societal perspective we also find this development important, as PBL - and education more generally - is increasingly important. No doubt that in the years to come 2016 will stand out in many ways as a particularly disturbing year. Europe has been marked by Brexit, but also a humanitarian crisis. The latter has unfortunately shown both cracks and conflicts in the European collaboration and an appalling lack of will to tackle the challenge of refugees seeking shelter in Europe. This year, more than 4000 people, men, women and children have died in their attempt to cross the mediterranean, and within the EU we have not been able to agree on how to distribute the refugees who managed to survive the dangers - or rather, there seems to be an agreement, but not the willingness among member states to put words behind their actions and accept the allotted number of refugees. No more decisive do we seem as a global community to address the atrocities happening in Syria, and Yemen, and so many other places where people are displaced or killed. Many of

* Thomas Ryberg, Aalborg University, Rendsburggade 14, 9000 Aalborg. E-mail: ryberg@hum.aau.dk
Jacob Davidsen, Aalborg Universtiy, Rendsburggade 14, 9000 Aalborg. E-mail: jdavidsen@hum.aau.dk
Bettina Dahl, Aalborg University, Vestre Havnepromenade 5, 9000 Aalborg. E-mail: bdahls@plan.aau.dk

the conflicts we are witnessing are difficult to understand and disentangle, who are the parties fighting, what are the vested interest of the superpowers in terms of trades and alliances, who should we support? These are questions that are difficult to resolve for the individual citizen - educated or not - but more concerning they are also conflicts it seems both politicians and media struggle to fathom.

The year of 2016 also became the year where notions of post-truth and post-factual gained widespread attention. Post-truth became Oxford Dictionaries 'word of the year' in both US and UK. In for instance both the leave and remain campaigns, as part of the Brexit elections, outrageously false and deceptive claims were. It has been a year where the internet has revelled in Fake News, and it has become clear that entire businesses are built around promoting claims that are farfetched lies.

While one could hope for a less turbulent 2017 it also seems clear we are facing a number of global challenges. With increasing popularity of nationalist-populist parties across Europe we could be facing a surge in post-factual, populist claims and news as elections in a number of European countries are nearing. And as sociologist Matthijs Rooduijn writes in a recent column in nature it is questionable whether simply studying populism is enough, and he urges academics to 'step up and choose sides' (Rooduijn, 2016).

So, what are the relations between these disturbing trends, PBL and calls to 'step up' the reader might ask. For us it underlines the importance of understanding PBL, not only as a technique for teaching more effectively, but as an educational philosophy that should underpin Higher Education practice. In our view, PBL is equally about enabling students to engage in critical enquiry at societal level, and thus more than developing skills we see PBL (and Higher Education more generally) as a means to develop critical, enlightened citizens. Acc In Aalborg University (and Roskilde) where students work with real-life problems in projects for extended periods of time, we should perhaps also be more insistent in our encouragements for students to critically engage with societal issues. How can areas such as social science, education and computer science help us understand how we can resist and battle fake news, post-truths, misinformation and outright lies. In many understandings of PBL it is a pedagogy that goes further than the classroom - it is a pedagogy and philosophy that brings the world and academia in closer alignment. It is, in our view, a pedagogy that should encourage teachers and students to stretch out and attempt to become change agents. While PBL is often about empowering the students in terms of autonomy, self-direction and choice in relation to education, we need perhaps to strengthen our focus on the world outside the educational institutions.

The papers in different ways help us in this regard. For example, the paper by Ravn and Jensen explicitly discuss 'PBL and the postmodern condition - Knowledge Production in University Education'. Based in Lyotard they discuss how University Education is

increasingly marked by marketization and preoccupied with efficiency and performativity over 'truth' and human emancipation. In some ways, the authors argue, PBL is part of this trend, where there is an increased interest in 'usable and applied mode 2 knowledge' and industry-university partnerships. PBL can clearly be understood as part of this line of thinking, however, the authors equally argue that the original thoughts on PBL, as reiterated by Bøgelund & Kolmos (2013), were oriented towards emancipation and social change, and PBL could or should focus on the ideal of students as change agents in a globalised world. The paper by Aničić & Mekovec (2016) show the positive aspects of bringing practice and theory closer together. For example, in their paper "Introducing Problem-Based Learning to Undergraduate IT Service Management Course: Student Satisfaction and Work Performance" Aničić & Mekovec (2016) write: *"The presented results can be considered a new aspect of the development and amendment of the information and communication technology (ICT) skills requested by future employers. In this regard, the demand for innovation in the education of future ICT professionals arises from the need for experts equipped with both IT and business skills."*. In the citation we see the positive aspects of bringing closer together real-world practice and skills with higher education with PBL as the pedagogical means to facilitate this meeting.

The paper by Lund & Jensen (2016) also touches upon the intersections between education and industry. In their paper "Dealing with Insecurity in Problem Oriented Learning Approaches" they report from an experiment where students use the it-tool KUBUS to scaffold their formulation of a research problem. The KUBUS tool is an industry tool developed to manage innovation processes in companies, and the authors analyse both the challenges and potentials of adopting the tool as part of students' inquiry processes. In a similar vein Swaal & Otting (2016) analyse students understanding of and how they apply the well-known Seven Step Procedure. While the method is well-known the authors argue that: *"So far, little is known about how students rate the performance and importance of the different steps, the amount of time they spend on each step and the perceived quality of execution of the procedure."*

This issue further contains four cases. PBL cases are not research papers but a shorter communication whose purpose is to disseminate experiences with PBL to inspire others who are already doing PBL or someone considering to do so but in need for ideas on how to do it in practice. The four cases are from all over the world and in different types of disciplines: One of the cases by McLoone, Lawlor & Meehan (2016) focuses on developing a PBL model in the first year of a Bachelor of Electronic Engineering in Ireland. Demikhova (2016) presents and analyses a case of implementing innovative information and communication technologies and PBL in medical education in Ukraine. The third case by Wood (2016) focuses on how PBL is used in educating archaeology students to enhance their employability skills in the UK. Finally a fourth case, by Arantes do Amaral, Petroni & Hess (2016) is from Brazil and focuses on fundraising strategies developed by MBA students in a PBL course.

The four cases are from different parts of the world and stem from different disciplines and faculties. However, the ideas and experiences presented in these four cases are also inspirational to people from other faculties and disciplines. The cases show that PBL is a set of pedagogical ideas and principles that can be applied within a range of different context. While the concrete implementations may vary, and there might be disciplinary differences in terms of how the PBL principles are adopted, we do believe that the PBL cases offer opportunities for inspiration across disciplinary boundaries. We would encourage readers to submit cases about PBL to share experiences and learn from each other about how to work with PBL in practice.

Finally, we should like to thank all the reviewers who have contributed to the improvement of the papers in 2016:

Andrew Armitage
Benoit Raucent
Bettina Dahl
Heilyn Camacho
Jeppe Emmersen
Jørgen Nielsen
Mahyuddin Bin Arsat
Manfred Muehlfelder
Ole Ravn
Palle Rasmussen
Petar Jandrić
Pia Bøgelund
Pär-Ola Zander
Robert Lawlor
Roger Hadgraft
Simon Heilesen
Tom Nyvang

References

Bøgelund, P., & Kolmos, A. (2013). Ph.d.-vejledning i et akademisk, markedsdrevet og samfundsforandrende perspektiv. Dansk Universitetspædagogisk Tidsskrift, 8(15), 99–111.

Rooduijn, M. (2016). Simply studying populism is no longer enough. Nature News, 540(7633), 317. https://doi.org/10.1038/540317a

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 1-15
http://dx.doi.org/10.5278/ojs.jpblhe.v0i0.1173

Performance of the Seven-step Procedure in Problem-based Hospitality Management Education

*Wichard Zwaal, Hans Otting**

ABSTRACT

The study focuses on the seven-step procedure (SSP) in problem-based learning (PBL). The way students apply the seven-step procedure will help us understand how students work in a problem-based learning curriculum. So far, little is known about how students rate the performance and importance of the different steps, the amount of time they spend on each step and the perceived quality of execution of the procedure. A survey was administered to a sample of 101 students enrolled in a problem-based hospitality management program. Results show that students consider step 6 (Collect additional information outside the group) to be most important. The highest performance-rating is for step two (Define the problem) and the lowest for step four (Draw a systemic inventory of explanations from step three). Step seven is classified as low in performance and high in importance implicating urgent attention. The average amount of time spent on the seven steps is 133 minutes with the largest part of the time spent on self-study outside the group (42 minutes). The assessment of the execution of a set of specific guidelines (the Blue Card) did not completely match with the overall performance ratings for the seven steps. The SSP could be improved by reducing the number of steps and incorporating more attention to group dynamics.

Keywords: Seven-step procedure, problem-based learning, hospitality management education.

* Wichard Zwaal, Stenden Hotel Management School, The Netherlands, Email: w.zwaal@stenden.com
Hans Otting, Stenden Hotel Management School, The Netherlands, Email: johannesotting@gmail.com

INTRODUCTION

In the past decades, higher education has introduced educational approaches in which students are involved in active, self-regulated, collaborative and constructive learning. The adoption of a social constructivist conception of education has brought about a shift of focus from teaching to learning. Problem-based learning is an approach to education that is generally seen as emblematical of social constructivist conceptions of education. Characteristic for problem-based learning is that students learn in small groups by collaboratively solving problems and working on unstructured tasks. Experiences with the facilitation of the learning processes in problem-based learning by tutors have shown differences and difficulties in structuring and coaching the process. Therefore, Schmidt (1982; 1983) introduced the seven-step procedure as a scaffold for PBL in order to help structure the explanation of underlying phenomena and processes, and the elaboration on knowledge to gain deeper understanding of the problem. In the PBL-process knowledge acquisition and knowledge application are integrated. Several authors have described the rationale and the different steps of the seven-step procedure (De Boer & Den Dulk, 2009; Dochy, Segers, Van den Bossche, & Struyven, 2005; Moust, Bouhuijs, & Schmidt, 2007; Schmidt, 1982; 1983; Williams, 1992; Authors, 2010; 2012; 2014). The seven-step procedure structures the cumulative process of knowledge building in PBL-sessions and positively influences student achievement (Hmelo-Silver, 2004; Taylor & Miflin, 2008; Yew, Chng, & Schmidt, 2011; Yew & Schmidt, 2012). In this study of a problem-based hospitality management program we are interested in how students rate the performance and execution of the seven-step procedure in problem-based learning in general, and each of the seven steps of the procedure separately. The execution of the seven-step procedure can be problematic because many students have little prior experience in a systematic approach to problem-solving. Therefore, the 'blue card' with short explanations of every step of the seven-step procedure was introduced as a learning aid, and we study how students apply the blue card.

INTRODUCING THE SEVEN-STEP MODEL

Step 1: Clarify terms and concepts not readily comprehensible

The first step of the seven-step procedure confronts students with a real-life problem. Students have to carefully read the problem, must be able to paraphrase the problem, and summarize the problem in their own words. It is essential that students identify relevant concepts and facts. The students have to understand and agree on the core issues and concepts. When students have little prior knowledge relevant to solving the problem or if concepts and terms are subject to different interpretations, students have to make a working list in which they explicitly state what is known and what is unknown about the problem.

It is essential that the tasks that are used in problem-based learning are of a high quality to stimulate students' interest in the subject matter, increase time spent on self-study, and impact achievement (Norman & Schmidt, 2000; Van Berkel & Schmidt, 2000). An example of a PBL-task is shown below.

PBL task: The lures and limits of leverage.
Corine is the 37-year old CFO of a Dutch hotel chain called "The Windmill Hotels Group" (WHG) which is operating 58 hotels in the EMEA region. She is preparing for next week's shareholders meeting and checking the latest update on the financial performance of the company. The company is considering expansion to Asia and will need a substantial amount of capital to do so. Figures show that the leverage of the WHG is considerably higher than for their major Asian competitor "The Asian Hotel Consortium" (AHC).
She wonders how the leverage might affect the price-earnings ratio of the shareholders and the perceived attractiveness to invest in WHG. How much dividend should she pay the shareholders? Or should she rather retain the earnings for the expansion plans?

Step 2: Define the problem
By sharing their ideas, understandings, and knowledge about the problem and its interrelated phenomena, students construct a common understanding of the problem. The students define the exact nature of the problem and agree upon the phenomena that have to be explained.

Step 3: Analyze the problem
Based on the often incomplete information in the problem description students activate their prior knowledge, and use their thinking and problem solving skills to elaborate on the contents of the task. In a round of free association they can express ideas, thoughts, questions, opinions, concepts, and hypotheses about the problem and its underlying mechanisms. Brainstorming techniques are often used for the generation of ideas. Students are encouraged to freely express themselves and to avoid criticism and discussion about the quality of ideas while brainstorming. The main objective of the analyzing phase is twofold. First, students engage in a creative process that enables them to generate a list with a wide variety of facts, ideas and concepts. Second, after ideas have been generated, students explain and discuss the ideas, and ask critical questions to assess the quality of ideas. Inadequate execution of step three results in poor and superficial problem analysis with little elaboration on prior knowledge (De Grave, Boshuizen, & Schmidt, 1996; Moust, Van Berkel, & Schmidt, 2005).

Step 4: Draw a systemic inventory of the explanations inferred from step 3
Collaboration in PBL-groups is important because students have to develop a common understanding of the problem not only at the individual level but also on the group level. Different viewpoints and interpretations must be discussed, interrelated, and negotiated to attain shared conceptions and a shared mental model, which functions as a context for future communication, collaboration, and joint activities (Akkerman, Van den Bossche, Admiraal,

Gijselaers, Segers, Simons, & Kirschner, 2007). Unlike the unstructured process of ideas generation, the systematic inventory in step four provides a structure for the problem analysis that took place in the previous step of the seven-step procedure. The various explanations of the problem are placed in a systematic inventory.

Concept mapping, a graphical tool that promotes conceptual thinking and understanding, has been introduced to improve student learning in problem-based learning (Addae, Wilson, & Carrington, 2012; Hsu, 2004; Johnstone & Otis, 2006; Kassab & Hussain, 2010; Rendas, Fonseca, & Rosado Pinto, 2006; Authors, 2012). Notwithstanding promising experiences with concept mapping, research on the implementation of concept mapping in problem-based learning has not yet shown convincing empirical evidence.

Step 5: Formulate learning issues

In the previous steps, the students have formulated what they already know about the problem, have generated ideas, and made a systematic inventory of possible explanations. In step five, students formulate learning issues that will guide learning outside the PBL-tutorial. These learning issues emerge in the PBL-tutorial through discussion and negotiation. Three conditions for learning issues must be met: 'there must be a recognizable knowledge deficiency, the students must see the missing knowledge as relevant to or necessary for the eventual practice, and, finally, there must be consensus about the timelines of undertaking the study' (Koschmann, Glenn, & Conlee, 1997, p. 2). Van den Hurk, Dolmans, Wolfhagen, and Van der Vleuten (1998) formulated three criteria for student generated learning issues in step five of the seven-step procedure. A proper learning issue: 1. should contain keywords; 2. include a concise description of the main aspects of the learning topics; 3. should be understood regarding purpose and content by all members of the PBL-group.

Several studies show that a considerable percentage of task-constructor's preset learning objectives were not identified by the students in the PBL-sessions. Dolmans, Gijselaers, Schmidt, & Van der Meer (1993) listed three characteristics of these mismatches:

1. the objectives were related to the curriculum but not specifically to the problem in question;
2. the objectives were covered by more than one problem;
3. psychological and social objectives (in a medical curriculum) were often not detected.

Moreover, Dolmans, Schmidt & Gijselaers (1995) could not confirm that the student-generated learning issues were used as the major factor influencing students' self-study activities. Self-study activities can also be influenced by the availability and selection of resources, course objectives, tutor interventions, additional lectures, and assessment procedures.

Step 6: Collect additional information outside the group

Students are supposed to search for relevant literature from a diversity of sources. The library is an important source of information and the e-library provides access to databases, e-journals, e-dictionaries, and e-books which facilitates the search for relevant literature. The quality and reliability of other Internet sources is not always evident. Moreover, experts inside and outside the university can be consulted to get additional information. The students select and study literature that they consider worthwhile for attaining their learning goals. The time available for individual study is a decisive factor for graduation rates and study duration (Schmidt, Cohen-Schotanus, Van der Molen, Splinter, Bulte, Holdrinet, & Van Rossum, 2010). It is essential that tutors, who facilitate PBL-tutorials, emphasize the importance of self-study to the students, set norms for the amount of time and effort students should devote to self-study, and give feedback to the students about the level of learning and knowledge (Nuutila, Törmä, & Malmi, 2005). Musal, Gursel, Taskiran, Ozan, and Tuna (2004) found that first-year medical students spent more time on self-study than third-year students. First-year students generally restrict themselves to the learning issues that were agreed upon in step five, while senior students use the guidelines in a more flexible manner and tend to follow their own learning interests. Students who study beyond the learning objectives spend more time on self-study and gain better results on knowledge tests (Van den Hurk, Wolfhagen, Dolmans, & Van der Vleuten, 1999; 2001).

In a problem-based curriculum, effective and efficient allocation of time for instruction is necessary to allow for sufficient self-study time. The total time that students want to invest in (medical) education generally does not exceed 37 hours per week (Gijselaers & Schmidt, 1995). Whereas time for instruction and time for self-study is limited, the question arises how much time must be allocated for instruction in relation to self-study time to maximize the total time students spend on studying. The restricted total time students are expected and willing to spend on education implies that there is a trade-off between the time for instruction and self-study time whereby an increase in time for instruction over 10 to 12 hours per week is associated with a decrease in time spent on self-study (Gijselaers & Schmidt, 1993, 1995; Torenbeek, Jansen, & Suhre, 2013). Curriculum activities that reduce the time for self-study negatively influence graduation rates and extend study duration (Schmidt et al, 2010).

Step 7: Synthesize and test the newly acquired information

After the individual research and self-study, the newly acquired knowledge is shared and discussed with the other group members. The students relate the acquired knowledge to the problem and evaluate what they have learnt from the problem, which helps them to apply their knowledge to other problems The individual study of relevant information in preparation to the reporting phase influences the breadth and depth of discussion in the reporting phase (Van den Hurk, Dolmans, Wolfhagen, Muijtjens, & Van der Vleuten, 1999). When students don’t spend enough time on literature search, study the same literature, restrict themselves to

the learning issues, and don't study beyond the issue in question, it does not come as a surprise that they have little to discuss and that elaboration and synthesizing of knowledge is insufficient. The necessary synthesis and integration of knowledge in step seven is often reduced by the students to reporting findings without any discussion or reflection on the newly required information (Moust, Van Berkel, & Schmidt, 2005).

Research by Visschers-Pleijers, Dolmans, De Grave, Wolfhagen, Jacobs, and Van der Vleuten (2006) using focus group interviews of 48 undergraduate students about their perception of factors that contribute to the effectiveness of the reporting phase yielded four main characteristics:

1. Giving and receiving explanations.
   Students explain the findings in their own words, discuss these findings, check information and interpretations, and receive feedback from one another. The tutor plays a significant role in giving just-in-time and just-enough guidance to further students' in-depth discussion of learning content.

2. Integrating and applying knowledge.
   Structured discussions, summary of information, and explanations of the relations with the prior phases contribute to further understanding and integration of knowledge. Relating theory to practice by giving examples and exploring problems of the same kind fosters broader understanding of learning contents.

3. Discussing unclear information and expressing opinions.
   As students find and study from diverse literature sources discussions about diverging views and different interpretations may lead to improved integration of information and deeper understanding of learning contents.

4. Guiding and monitoring the discussions in the PBL-tutorial.
   The tutor and the chairperson of the PBL-tutorial guide the discussions and the group process to allow for active participation of all group members. Giving and receiving feedback both on the contribution to the group process and the contents of the discussions are essential for sharing information and reaching consensus on the main learning contents. The creation of a safe learning environment is important to deal with conflicts about knowledge issues. Most of the study time in the reporting and discussion phase is spent on cumulative reasoning, a learning-oriented interaction leading to consensus on knowledge, without much challenging of mutual contributions. On average 7% of the time in the PBL-tutorial was spent on conflicts and evaluations of knowledge that were beneficial for gaining understanding (Visschers-Pleijers, Dolmans, De Leng, Wolfhagen, & Van der Vleuten, 2006).

PROBLEM STATEMENT AND RESEARCH QUESTIONS

The main goal of this study is to generate an overview of student perceptions about the way each of the seven steps is executed in the sessions they have experienced so far. The problem statement is: How do students appreciate the performance and execution of the seven-step procedure in problem-based learning?

The following research questions will be addressed:

1. How do students rate the performance of the seven-step procedure?
2. How do students rate the importance of the seven-step procedure?
3. How much time do students spend on each of the separate steps?
4. How do students assess the application of the blue card?

METHOD

Context of the study

Students of the Hotel Management School of a University of Applied Sciences in the Netherlands participated in this study. The hotel school was the first school of the university to implement problem-based learning in 1987. The curriculum can be characterized as a hybrid PBL-curriculum indicating that problem-based learning is supported by other, often more teacher-oriented, educational methods like lectures and workshops to support students' learning.

Problem-based learning is integrated in all four thematic-interdisciplinary modules in the first three years of the Bachelor program. The PBL-groups consist of twelve students and meet twice a week for 90 minutes in PBL-tutorials. A real-life PBL-task is used as a stimulus for the learning process in the PBL-tutorial.

Sampling and data collection

Five tutors allowed us to administer a survey to six first-year tutorials in the module "Guest Experience", three second-year workshops in the module "Operations Design", and three third-year tutorials in the module "Strategic Hospitality Management". All data were collected in the final week of a module at the beginning of the PBL-tutorials and workshops. On average the students spent about 15 minutes to fill out the questionnaire. The students participated voluntarily and received no incentives or compensation for their participation.

In total 101 students participated in the study. Students were from different years of study: 47 first-year students, 35 second-year students, and 19 third-year students. Most of the students were female (71.3%). The age of the respondents ranged from 17 to 29 with a Mean of 20.31

(SD = 2.13). In the sample 79.2% of the students are from the Netherlands and the international students come from Germany, China, Ukraine, Thailand and Bulgaria.

Instrumentation

The survey consists of three sections. Section one includes three blocks: (a) rating the importance by dividing 100 points over the seven steps; (b) rating of the performance (= perceived quality of execution) of each of the steps using a report mark (1 = poor; 10 = excellent); (c) estimating how much time is spent on each of the seven steps. In section two, subjects are asked to provide an overall mark on each of the following three issues: problem-based learning, the seven-step procedure and the Blue Card. Section three contains 27 statements derived from the Blue card and related to the execution of each of the seven steps.

Data analyses

For the three blocks in section one, descriptive statistics will be provided and the performance and importance scores will be combined into an Importance-Performance Matrix. Section two will be analyzed using the mean and standard deviation for each of the ratings. Finally, we will compare the performance scores from section one (report marks) with the performance scores from section three (Blue Card).

RESULTS

Importance, performance and time

Students divided 100 points over the seven steps (with a minimum of one point per step) to measure the relative importance of each of the seven steps. As shown in table 1, students consider step six (collect additional information outside the group) to be the most important step, while step one (clarify terms and concepts) is lowest in the ranking.

	Mean	SD
Step 6: Collect additional information outside the group	17.42	7.80
Step 5: Formulate learning issues	15.86	6.99
Step 2: Define the problem	15.34	7.17
Step 3: Analyze the problem	15.30	5.75
Step 7: Synthesize and test the newly acquired information	14.38	6.78
Step 4: Draw a systemic inventory of explanations from step 3	11.31	5.06
Step 1: Clarify terms and concepts not readily comprehensible	10.46	6.21

Table 1: Importance of the seven steps (n = 101).

As shown in table 2 the quality of performance for each of the steps using a report mark from 1 to 10 ranges from 6.43 (step four) to 7.08 (step two).

	Mean	SD
Step 2: Define the problem	7.08	1.25
Step 5: Formulate learning issues	7.00	1.45
Step 3: Analyze the problem	7.00	1.28
Step 6: Collect additional information outside the group	6.93	1.75
Step 7: Synthesize and test the newly acquired information	6.73	1.61
Step 1: Clarify terms and concepts not readily comprehensible	6.61	1.50
Step 4: Draw a systemic inventory of explanations from step 3	6.43	1.37

Table 2: Performance of the seven steps (n = 101)

The combination of the performance and importance scores in an Importance-Performance matrix (table 3) shows that four of the seven steps are classified high on performance and importance, two steps are qualified as low performance and low importance, and step seven is classified as low in performance and high in importance. The high importance-low performance cell of the matrix is generally considered as an issue needing immediate attention.

	High Performance (> 6.83)	Low Performance (< 6.83)
High Importance (> 14.29)	Step 2 , Step 3, Step 5, Step 6	Step 7
Low Importance (< 14.29)		Step 1, Step 4

Table 3: Importance-Performance Matrix.

In table 4, the total amount of time spent on the seven steps adds up to about 133 minutes. The largest amount of time is spent on self-study outside the group (M = 42 minutes) and the smallest amount on step one (M = 8 minutes).

	Min	Max	Mean	SD
Step 6: Collect additional information outside the group	0	150	42.05	40.63
Step 7: Synthesize and test the newly acquired information	0	90	25.82	21.66
Step 5: Formulate learning issues	5	60	16.69	8.09
Step 3: Analyze the problem	5	40	15.41	7.56
Step 4: Draw a systemic inventory of explanations from step 3	5	50	15.35	7.,39
Step 2: Define the problem	3	30	11.11	4.88
Step 1: Clarify terms and concepts not readily comprehensible	2	20	8.09	3.62

Table 4: Time spent on each of the seven steps (n = 101).

Overall mark for problem-based learning, seven-step procedure and Blue Card

In table 5, the overall mark for problem-based learning, the seven-step procedure and the Blue Card are shown.

	Year 1	Year 2	Year 3	Overall	SD
PBL	7.85	7.00	7.32	7.45	1.28
Seven-step procedure	6.98	6.97	5.58	6.71	1.18
Blue Card	6.65	7.06	5.47	6.57	1.70

Table 5: Overall report mark for problem-based-learning, seven-step procedure and Blue Card (n = 101)

ANOVA shows significant differences between the three years regarding their rating of problem-based learning ($F_{2,96} = 4.768$; $p = .011$), the seven-step procedure ($F_{2,96} = 13.477$; $p = .000$) and the Blue Card ($F_{2,96} = 5.931$; $p = .004$). The more senior students have a lower appreciation for PBL, the seven-step procedure and the Blue Card. This is also reflected in the significantly negative correlation of the three variables with the amount of credits earned. No significant differences in ratings of PBL, seven-step procedure, and Blue Card were detected between males and females or different nationalities.

Perceived application of Blue Card guidelines

In the last section of the survey, students were asked to indicate to what extend they agreed with the guidelines in the Blue Card. The aggregate means per step in table 6 shows the following ranking of perceived performance: step 2 (M = 3.99), step 1 (M = 3.82), step 3 (M = 3.81), step 5 (M = 3.56), step 4 (M = 3.27), step 6 (M = 3.25) and step 7 (M = 3.09).

	Mean	SD
Step 1: Clarify terms and concepts not readily comprehensible	3.82	.59
Step 2: Define the problem	3.99	.49
Step 3: Analyze the problem	3.81	.66
Step 4: Draw a systemic inventory of explanations from step 3	3.27	.74
Step 5: Formulate learning issues	3.56	.49
Step 6: Collect additional information outside the group	3.25	.67
Step 7: Synthesize and test the newly acquired information	3.09	.56

Table 6: Perceived application of Blue Card guidelines (n = 101)

The ranking of the perceived performance of the seven steps in table 6 does not match the one listed in table 2.

DISCUSSION

The main goal of this study was to investigate how students apply the seven-step procedure in problem-based learning because the execution of the seven-step procedure reflects the way students learn in a problem-based curriculum. If students interpret or apply the procedure in the wrong way, or spend insufficient time on critical steps in the process, that will harm the amount and quality of learning by the group members.

Performance of the seven-step procedure was measured by an overall mark for each of the seven steps and by 27 statements about the perceived application of Blue Card guidelines. The ranking of the seven steps in both approaches did not exactly match. This raises the question about the concurrent validity of the two measurements, which could be investigated by a sample of PBL-groups assessing one single PBL-session with both instruments.

The total amount of time spent per task (M=133 minutes) is way below the overall targeted figure of 400 minutes per task. Especially the limited amount of time (M=42 minutes) students spend on self-study in step six leaves a lot to be desired. Therefore, tutors could pay more attention to the quality of the execution of steps five, six and seven of the seven-step procedure. What learning goals do students formulate and is it clear to all students how much study time they need to spend on self-directed study? The focus of step seven should rather be on discussion of the findings and elaboration on knowledge than on just reporting. That will enhance not only the amount of active self-study time but also the opportunities for deep learning instead of surface learning.

Students experience difficulties with step four of the seven-step procedure. Both the importance and performance scores on step four are low. Students often don't seem to grasp the essence of step four and find it difficult to critically review and systemize the diverse ideas and explanations into a conceptual framework. Recently, we introduced concept mapping in step four to restructure the prior knowledge of the students by visualizing the relations between the various concepts. As the problems with step four persist, more research is needed to determine the format and conditions that would make concept mapping a useful operationalization of step four in the seven step procedure (Authors, 2012).

The Importance-Performance matrix showed that step seven (Synthesize and test newly acquired information) was classified as an important but underperforming part of the procedure. Although students spent on average 26 minutes per task on this step they rank it fifth in the Performance rating (M = 6,73) and last using the Blue Card guidelines. Since the Importance-Performance matrix was based on a relative norm we should be careful with the interpretation of the position of the different steps in the matrix. Although the mean score for step 7 (M = 6.73) falls below the aggregate mean of all seven steps (M = 6.83), the mark is far from insufficient.

When looking at the description of step 7 (*Synthesize and test the newly acquired information)* our personal experiences as a tutor in problem-based learning do confirm the weak performance of step 7. Students tend to report what they conceive of as the 'answers' to the learning goals, mostly relying on and limiting themselves to the basic textbooks, uncritically quoting sources, hardly ever asking for explications from other group members, never formulating additional learning goals, and never redrawing, adapting, expanding or elaborating on the conceptual map if any was developed in step 4. Linking the task to other problems in the module and making the connection to the module theme or module objectives is a great exception and not the rule. In order to improve the execution of step 7 we recommend to pay more attention to conceptualization, integration, critical evaluation and generalization of student contributions. It is clear that improvement of student performance on step seven should be given priority.

IMPLICATIONS AND RECOMMENDATIONS

The seven-step procedure seems to be primarily focused on what might be called the task-oriented dimension of problem-based learning and less on the group-oriented or social dimension. The seven-step procedure deals with cognitive and constructive learning from problems but offers little support for collaborative and self-directed learning. Our experiences with problem-based learning support the need for adaptation and extension of the seven-step procedure that would include tools for managing and monitoring group dynamics and the social dimension of the PBL-process. Students experience how difficult it can be to collaborate with one another in PBL-tutorials and how group dynamics may influence learning processes. More attention could be given to the social learning dimension by providing training for the PBL-tutors and students in productive collaboration and in diagnosing and managing group dynamics.

One of the difficulties in applying the seven-step procedure is distinguishing and managing the individual steps. Discussions in the PBL-tutorials do not always follow the sequence of the seven-step procedure. For instance, when in step one of the seven-step procedure a difficult concept that needs explanation is encountered, students tend to immediately translate that into a learning goal. Moreover, it is not always clear in which step of the seven-step procedure the discussion is. There seems to be a substantial overlap or interaction between the first five steps. Reducing the seven steps to three phases might be helpful. Research on the problem-based learning process often distinguishes three cyclical learning phases (Hmelo-Silver, 2004; Taylor & Miflin, 2008; Yew, Chng, & Schmidt, 2011):

Phase 1. The problem analysis phase with emphasis on orientation, task analysis, conceptualisation and goal setting (step one to five of the seven step procedure).

Phase 2. The self-directed study phase regards the collection of additional information outside the PBL-group and the individual study (step six of the seven-step procedure).

Phase 3. The discussion phase focusing on the reporting of findings, discussions, reflection, evaluation, and restructuring of information and knowledge (step seven of the seven-step procedure).

Next to the traditional seven-step procedure an e-PBL five-step model and a seven-step Optima model have been developed to provide more explicit scaffolding (Rienties, Giesbers, Tempelaar, Lygo-Baker, Segers, & Gijselaers, 2012). The Blue Card is used in this study to support problem-based learning as a scaffolding tool. However, the explicit use of the Blue Card as a guide for the seven-step procedure may be too restrictive for students who are able to study more autonomously. This study shows that third-year students have a relatively low appreciation for the seven-step procedure and the blue card which may indicate that they have become self-directed learners who's autonomy and freedom by using the Blue Card may become too limited which may have negative consequences for their motivation and contribution to collaborative learning in PBL-tutorials, while first-year students who often have more conventional conceptions about education might need even more support and guidance.

Balancing the amount of scaffolding and the need for autonomy differs over the years of study. Students in the third year value the use of the seven-step procedure and the Blue Card significantly lower than students in the first and second year. These students may need more freedom for pursuing individual learning goals and less scaffolding and guidance. The aim of successful scaffolding is to find a dynamic balance between learning autonomy and guidance to further self-directed, constructive and collaborative learning in the consecutive phases of curriculum. For senior students less structure and guidance, and more complex and challenging problems and cases might be indicated. Senior students can be challenged to go beyond a pre-structured procedure and find new and creative ways with more flexible scaffolding for dealing with problems (Wijnia, Loyens, & Derous, 2011). Instead of a ritualistic application of the seven-step procedure with marginal problem analysis, little studying beyond the learning goals, and spending less than half of the allocated study time outside the PBL-tutorials, students should be challenged to spend time and energy on profound problem analyses, studying beyond the learning goals, search for new information to attain in-depth knowledge by discussing the findings and evaluating the results in the PBL-tutorials (Segers & Dochy, 2001).

The seven-step procedure was developed at the beginning of the computer era when students were still largely dependent on books and journals in a library. Developments in information technology have made it possible to access information anytime and anywhere. How students search for relevant and reliable information outside the PBL-tutorial in step six of the seven-

step procedure could be supported by sophisticated and state-of-the-art digital information facilities to enhance the quality of self-directed learning.

References

Addae, J. I., Wilson, J. I., & Carrington, C. (2012). Students' perception of a modified form of PBL using concept mapping. *Medical Teacher,* 34(11), e756-e762.

Akkerman, S., Van den Bossche, P., Admiraal, W., Gijselaers, W., Segers, M., Simons, R-J., & Kirschner, P. (2007).Reconsidering group cognition: from conceptual confusion to a boundary area between cognitive and socio-cultural perspectives? *Educational Research Review,* 2, 39-63.

De Boer, M. R. & Den Dulk, H. (2009). *Ins and Outs of PBL: The Art of Learning in Tutorials.* (2nd Ed.) Internal publication. Leeuwarden: Stenden University of Applied Sciences.

Dochy, F., Segers, M., Van den Bossche, P., & Struyven, K. (2005). Students' perceptions of a problem-based learning environment. *Learning Environments Research,* 8, 41-66.

Dolmans, D. H. J. M., Gijselaers, W. H., Schmidt, H. G., & Van der Meer, S. B. (1993). Problem effectiveness in a course using problem-based learning. *Academic Medicine,* 68(3), 207-213.

Dolmans, D. H. J. M., Schmidt, H. G., & Gijselaers, W. H. (1995). The relationship between student-generated learning issues and self-study in problem-based learning. *Instructional Science,* 22, 251-267.

Gijselaers, W. H., & Schmidt, H. G. (1993). Investeren in instructietijd: spaarzaamheid loont de moeite. *Onderzoek van Onderwijs,* November, 57-60.

Gijselaers, W. H., & Schmidt, H. G. (1995). Effects of quantity of instruction on time spent on learning and achievement. *Educational Research and Evaluation,* 1(2), 183-201.

Hmelo-Silver, C. E. (2004). Problem-based learning: what and how do students learn? *Educational Psychology Review,* 16(3), 235-266.

Hsu, L-L. (2004). Developing concept maps from problem-based learning scenario discussions. *Journal of Advanced Nursing,* 48(5), 510-518.

Johnstone, A. H., & Otis, K. H. (2006). Concept mapping in problem based learning: a cautionary tale. *Chemistry Education Research and Practice*, 7(2), 84-95.

Kassab, S. E., & Hussain, S. (2010). Concept mapping assessment in a problem-based medical curriculum. *Medical Teacher*, 32, 926-931.

Koschmann, T., Glenn, P., & Conlee, M. (1997). Analyzing the emergence of a learning issue in a problem-based learning meeting. *Medical Education Online,* 2(2), 1-9.

Moust, J. H. C., Bouhuijs, P. A. J., & Schmidt, H. G. (2007). *Introduction to problem-based learning. A guide for students.* Groningen/Houten: Wolters-Noordhoff.

Moust, J. H. C., Van Berkel, H. J. M., & Schmidt, H. G. (2005). Signs of erosion: Reflections on three decades of problem-based learning at Maastricht University. *Higher Education,* 50, 665-683.

Musal, B., Gursel, Y., Taskiran, H. C., Ozan, S., & Tuna, A. (2004). Perceptions of first and third year medical students on self-study and reporting processes of problem-based learning. *BMC Medical Education,* 4(16).

Norman, G. R., & Schmidt, H. G. (2000) Effectiveness of problem-based learning curricula: theory, practice and paper darts. *Medical Education,* 34, 721-728.

Rendas, B., Fonseca, M., & Rosado Pinto, P. (2006). Toward meaningful learning in undergraduate medical education using concept maps in a PBL pathophysiology course. *Advances in Physiology Education,* 30, 23-29.

Rienties, B., Giesbers, B., Tempelaar, D., Lygo-Baker, S., Segers, M., & Gijselaers, W. (2012). The role of scaffolding and motivation in CSCL. *Computers & Education,* 59, 893-906.

Schmidt, H. G. (1982). *Activatie van voorkennis, intrinsieke motivatie en de verwerking van tekst. Studies in probleemgestuurd onderwijs.* Apeldoorn: Van Walraven.

Schmidt, H. G. (1983). Problem-based learning: rationale and description. *Medical Education*, 17, 11-16.

Schmidt, H. G., Cohen-Schotanus, J., Van der Molen, H. T., Splinter, T. A. W., Bulte, J., Holdrinet, R., & Van Rossum, H. J. M. (2010). Learning more by being taught less: a "time-for-self-study" theory explaining curricular effects on graduation rate and study duration. *Higher Education*, 60(1), 287-300.

Segers, M., & Dochy, F. (2001). New assessment forms in problem-based learning: the value-added of the students' perspective. *Studies in Higher Education*, 26(3), 327-343.

Taylor, D., & Miflin, B. (2008). Problem-based learning: where are we now? *Medical Teacher*, 30(8), 742-763.

Torenbeek, M., Jansen, E., & Suhre, C. (2013). Predicting undergraduates' academic achievement: the role of the curriculum, time investment and self-regulated learning. *Studies in Higher Education*, 38(9), 1393-1406.

Van Berkel, H. J. M. & Schmidt, H. G. (2000). Motivation to commit oneself as a determinant of achievement in problem-based learning. *Higher Education*, 40, 231-240.

Van den Hurk, M. M., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., Muijtjens, A. M. M., & Van der Vleuten, C. P. M. (1999). Impact of individual study on tutorial group discussion. *Teaching and Learning in Medicine*, 11(4), 196-201.

Van den Hurk, M. M., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., & Van der Vleuten, C. P. M. (1998). Essential characteristics of student-generated learning issues in a problem-based curriculum. *Medical Teacher*, 20(4), 307-309.

Van den Hurk, M. M., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., & Van der Vleuten, C. P. M. (2001). Quality of student-generated learning issues in a problem-based curriculum. *Medical Teacher*, 23(6), 567-571.

Van den Hurk, M. M., Wolfhagen, I. H. A. P., Dolmans, D. H. J. M., & Van der Vleuten, C. P. M. (1999). The impact of student-generated learning issues on individual study time and academic achievement. *Medical Education*, 33, 808-814.

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., De Leng, B. A., Wolfhagen, I. H. A. P., & Van der Vleuten, C. P. M. (2006). Analysis of verbal interactions in tutorial groups: a process study. *Medical Education*, 40, 129-137.

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., De Grave, W. S., Wolfhagen, I. H. A. P., Jacobs, J. A., & Van der Vleuten, C. P. M. (2006). Student perceptions about the characteristics of an effective discussion during the reporting phase in problem-based learning. *Medical Education*, 40, 924-931.

Williams, S. M. (1992). Putting case-based instruction into context: examples from legal and medical education. *The Journal of the Learning Sciences*, 2(4), 367-427.

Yew, E. H. J., Chng, E., & Schmidt, H. G. (2011). Is learning in problem-based learning cumulative? *Advances in Health Sciences Education*, 4(16), 449-464.

Yew, E. H. J., & Schmidt, H. G. (2012). What students learn in problem-based learning: A process analysis. *Instructional Science, 40(2*), 371-395.

Authors (2010). The process of problem-based hospitality management education. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 9(2), 17-30.

Authors (2012). The impact of concept mapping on the process of problem-based learning. *The Interdisciplinary Journal of Problem-based Learning*, 6(1), 103-126.

Authors (2014). Student opinions about the seven-step procedure in problem-based hospitality management education. *Journal of Problem-based Learning in Higher Education, 2*(1), 18-28.

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 16-37
http://dx.doi.org/10.5278/ojs.jpblhe.v0i0.1409

Introducing Problem-Based Learning to Undergraduate IT Service Management Course: Student Satisfaction and Work Performance

Katarina Pažur Aničić, Renata Mekovec *

ABSTRACT

This paper describes the implementation of problem-based learning (PBL) principles in an undergraduate IT service management course, followed by the results about student satisfaction and work performance. The results indicate the students' general satisfaction with the course implementation, as well as some challenges regarding the self-assessment and peer assessment of their work. The findings also reveal the students' better work performance in project results than in traditional knowledge tests, which reinforces the indications about their positive attitudes towards the interactive PBL environment. The cluster analyses identified seven different patterns in student behaviour regarding course performance. Findings from this study could be used by both researchers and practitioners in their efforts to create or further research a stimulating, interactive learning environment based on PBL that improves the preparation of students for their future workplaces.

Keywords: Problem-based learning, student performance, student satisfaction, cluster analysis.

INTRODUCTION AND MOTIVATION

Current predictions about future trends in the demand for information and communication technology (ICT) professionals in Europe present three different scenarios for the period until 2020 (Gareis et al., 2014). In all three cases, the demand potential exceeds the predicted number of ICT graduates. Therefore, the graduate labour market supply and demand has

* Katarina Pažur Aničić, University of Zagreb, Faculty of Organization and Informatics.
E-mail: kpazur@foi.hr
Renata Mekovec, University of Zagreb, Faculty of Organization and Informatics.
E-mail: renata.mekovec@foi.hr

emerged as an important issue for research (Atfield & Purcell, 2010; Mourshed, Patel, & Suder, 2013) and has found its place in policy documents as well. Preparing graduates in the ICT field for a successful professional career requires continuous improvement in the educational process and curriculum design (Ali & Aliyar, 2012; Pilgrim, 2013), which includes new teaching methods and collaboration with employers. Innovative teaching methods, such as work-ready learning activities (Costley & Dikerdem, 2012; Litchfield & Sixsmith, 2010; Shukla, Costley, & Inceoglu, 2011), experience-based learning (Matsuo, Wong, & Lai, 2008), practice-based learning (Hynes, Costin, & Birdthistle, 2011), cooperative education programmes (Coll, Zegward, & Hodges, 2002), problem-based learning (PBL) (Intayoad, 2014) and so on, are increasingly finding their place in formal education.

The general aim of this paper is to provide a framework for organising and implementing a curriculum for an IT service management course, respecting the principles of (PBL) and related practices. The framework encompasses the definitions of all the main curriculum elements, including curriculum aims, intended learning outcomes, course content, learning and teaching methods and assessment (McKimm, 2007). The description of implemented framework is followed by the analysis of student satisfaction with certain curriculum elements implemented according to PBL principles, amended with the analysis of different patterns in students' behaviour regarding the assessment of their work performance during the course. In line with these research goals, the authors have proposed two research questions:

1) How do students assess particular aspects of this set learning environment, organised according to problem-based learning principles?
2) Is it possible to identify specific patterns in students' work performance in the established problem-based learning environment?

First, the paper brings short theoretical introduction on PBL principles, followed with the description of their implementation in IT service management course. In the Methodology chapter, we described two different methods used to answer the research questions – semantic differential scale for the assessment of different aspects of IT service management course organized according to PBL learning environment and cluster analysis for the identification of different patterns in students' work performance. Paper is concluded with the extensive Discussion of the results and implications for further research.

THEORETICAL BACKGROUND

This chapter contributes to the understanding of problem-based learning principles and provides detail explanation of IT service management curriculum elements.

Problem-based learning

Problem-based learning is a student-centred instructional approach (Popescu, 2012) that involves valorising the problems from the "real world" in the educational process to facilitate the development of students' critical thinking and problem-solving abilities and the assimilation of the fundamental concepts for different academic disciplines (Draghicescu, Petrescu, Cristea, Gorghiu, & Gorghiu, 2014). The PBL process sets goals for students to plan, communicate their ideas, gather information and implement and evaluate projects with real-world applications (Domínguez & Jaime, 2010) and are thus critical for learners in higher education to acquire genuine experiences (Heo, Lim, & Kim, 2010). Some authors describe PBL as the shift from traditional educational approaches to innovative ones that encourage lifelong, collaborative, student-centred and self-regulated learning (Baturay & Bay, 2010) and as such, contribute to the development of the students' necessary skills for their future workplaces. The relevant literature has also recognised the positive influence of PBL methods on the development of students' generic and transferable skills to fulfil the needs of the 21st-century job market, such as problem solving, creativity, teamwork and critical thinking, among others (Ersoy & Başer, 2014; Hung, Hwang, & Huang, 2012; Musa, Mufti, Latiff, & Amin, 2011, 2012; Şendağ & Ferhan Odabaşı, 2009). From the students' point of view, PBL contributes to improvements in terms of learning, motivation, enjoyment, involvement, teamwork quality and overall satisfaction, but it also increases their study time and effort compared with traditional learning (Popescu, 2012). Since PBL tasks refer to real-world problems, they are usually too complex for individual work and imply co-operation among students in the form of teamwork. In this manner, PBL often integrates co-operative learning (Heo et al., 2010) and can thus be described as an interactive learning environment based on real-world problem solving.

Implementation of PBL in IT service management course

To successfully achieve the positive effects of PBL, it is important to respect the principles of good PBL when planning the course organisation. This section describes the IT service management undergraduate course that was offered at the University of Zagreb, Faculty of organization and Informatics during the 2014–2015 academic year and attended by 140 regular students. At the end of the course, 115 students fulfilled all the course requirements although not all of them achieved the minimum score for a passing grade, which was 51 out of 100. The course description includes the main curriculum elements (Figure 1): its aims, intended learning outcomes, course content, learning and teaching methods and assessment, each of which is described in more detail in this section.

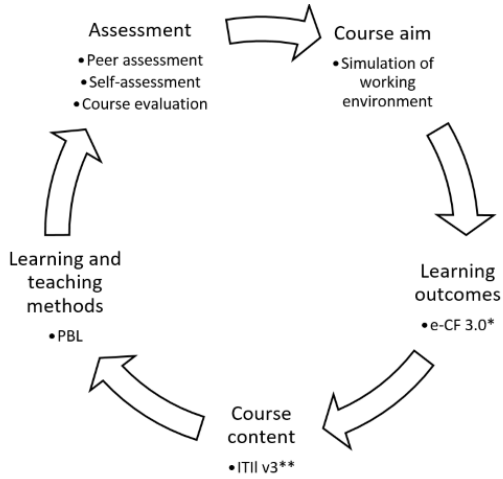

Figure 1. IT service management curriculum elements.

Course aim

The course's main aim was to teach students the management approach to IT service development, including not only the technical point of view but also the business perspective. The course was organised into 30 hours of lectures and 30 hours of laboratory exercises over a 17-week period. The main idea behind organising the course exercises was to put students in a similar environment to the one experienced in the real professional world, through the simulation of IT service development and communication processes with potential clients. The students were divided into teams of three or four members, each team representing a small IT company ('virtual company') with a task to develop an innovative IT service. In (Pažur Aničić and Mekovec 2014), we reported about the students' positive attitudes towards this kind of course organisation, as well as their increased motivation associated with the work in this type of learning environment. At the end of the course students were expected to deliver the prototype of the mobile or web application as the final product of their work, together with the related business documentation.

Course content, learning outcomes and performance plan

The course content was organised in line with the well-known Information Technology Infrastructure Library (ITIL) framework based on best practices in IT service management, *for the governance of IT and the management and control of IT services* (Cartlidge et al., 2011). The ITIL v3 service life cycle encompasses five stages: service strategy, service design, service transition, service operation and continual service improvement, which were used as guidelines for the development of the IT services performed by the students' virtual companies. The main learning outcomes of the course exercises were to enable students to:

1) work in a virtual company and define/perform all necessary steps in planning the new IT service,
2) prepare and participate in business meetings with potential clients and
3) design and present a prototype of their IT service.

Owing to the defined learning outcomes, the exercises were based on only two phases of the ITIL service life cycle – service strategy and service design. Each week, the course started with a two-hour lecture, introducing students to the theoretical knowledge related to the tasks and assignments to be performed during the upcoming exercises. To show the students the usefulness of certain skills and knowledge obtained for their potential professional profiles, the learning outcomes for each task within the exercises were connected to the European e-Competence Framework 3.0. (e-CF) (European Comitee for Standardization (CEN), 2014), as well as to generic competencies (Lokhoff et al., 2010).

With only goals and guidelines in front of them, through the implementation of PBL in the IT service management course, the students were encouraged to develop their generic and transferable skills, desired to fulfil the needs of the 21st-century job market. The teacher's role in this process was to moderate and direct the students' work to achieve the set goals. Most of the work was organised to be carried out during the 2-hour laboratory exercise each week since the opportunity to collaborate face-to-face within teams was necessary for a successful project output. Additionally, because ICT was perceived as useful for supporting students' teamwork (Heo et al., 2010), their collaboration was supported by the learning management system (LMS) Moodle, which contained all the materials necessary for a successful project output, as well as provided a "collaboration corner" for each team.

Teaching methods using PBL approach

To implement PBL concepts in the course, it was necessary to consider whether the idea would meet the requirements of a good PBL problem. According to (Duch, 2001), a good PBL problem should:

1) engage students' interest and motivate them to understand the context of the problem,
2) require students to make decisions/judgements based on the introduced principles or information,
3) be complex enough that a solution requires the co-operation of all team members,
4) include open-ended questions at the first stage of a problem and/or draw all team members into the discussion and
5) incorporate the course's content objectives into the problem, with a mandatory connection of previous knowledge to new concepts, as well as new knowledge to the concepts in other courses.

Furthermore, a good PBL problem (Lohman, 2002) has the following characteristics:

1) The problem should be unclear, and the information needed to solve it should be incomplete.
2) There should be more than one way to solve the problem.
3) The problem should not have a single right answer.

Another recommendation is that it should be intentionally complex, ill-structured, open-ended and have a holistic view of the problem or situation (Kolodner, Hmelo, & N. Hari, 1996). Moreover, collaboration of students or groups of students is a necessity, and the problem should also define the students' roles and goals. The positive aspects of a good PBL can be summarised as follows: "*An added benefit, if problems fit the criteria listed, is that, in general, they will require students to integrate knowledge from across multiple disciplines*" (Kolodner et al., 1996). Table A.1 in Appendix 1 lists the characteristics that the relevant literature associates with a good PBL problem, explaining the implementation of each characteristic in the IT service management course.

Assessment of students' work and course in general

The students' work was evaluated through two different types of activities during their course work: 1) 60 points for the individual knowledge obtained, as assessed through three tests during the semester, and 2) 40 points for teamwork, earned through project work. Altogether, five performance measurement attributes had effects on the students' final grade, namely, Test 1 (T1), Test 2 (T2), Test 3 (T3), project work – phase 1 (P1) and project work – phase 2 (P2). The students could also obtain 20 points for self-assessment (SA) and 20 points for peer assessment (PA), which were excluded from the final grade and used only as an experimental method for using SA and PA in interactive learning environments, which students were aware of. At the end of the semester, the students evaluated the results of their own work (SA) in the second project phase (presented as an application prototype in the form of a video through Wiki pages in Moodle). They also evaluated the results of their peers' work (PA), using the same criteria implemented in the form of rubrics in Moodle. Each student individually was randomly assigned two other projects to evaluate – they knew whose project they are evaluating, but they were also aware that the evaluated students would not know who of their peers have evaluated their work. The idea behind involving SA and PA was to determine how the scores obtained for both correlate with the students' performance in the project work, as assessed by the teacher, and with their individual success in theoretical knowledge tests. The relevant literature shows some work on the use of SA and PA by university student colleagues, stressing the issues that teachers deal with when including SA and PA as part of formal assessment. Regarding the positive aspects, PA activities are found to stimulate students to initiate critical thinking and provide objective judgements about the quality of the work being evaluated, as well as to offer constructive comments about possible improvements in future work (Yu & Wu, 2011). On the other hand, PA demands considerable time and effort from the teacher to organise and manage the assessment process (Chen, 2010). During

the entire teaching process, monitoring by teachers is important to avoid particular members' low level of collaboration and involvement in teamwork (Popescu, 2012). In fact, the efforts put into the project are not always shared equally by all team members. Other authors have recognised this problem in the existing literature on teamwork; consequently, they emphasise the need for improving the assessment methods in PBL (Fernandes, 2014).

Aside from the assessment of students' work, their satisfaction is an essential issue that should be considered when the perception of course quality or course content, as well as course effectiveness, is evaluated. The results presented by (Liaw & Huang, 2013) indicate that the learning activity could be affected by environmental characteristics, environmental satisfaction and learner characteristics. Therefore, we have also incorporated individual students' evaluation of different course aspects at the end of the semester, using the self-created semantic differential scale.

The methods and results of student performance and course satisfaction, both related to the assessment phase in the curriculum design, are described in the next section.

METHOD

Student satisfaction

At the end of the course, the students were given the opportunity to anonymously express their satisfaction with the laboratory exercises organized according to the PBL principles. A total of 123 students, of which 107 (87%) were male and 16 (13%) were female, filled the questionnaire about their satisfaction with certain course aspects. Most of the students (66%) stated that their initial interest in this course was medium, 21% assessed their interest as high, and 13% considered it low. The students were also asked to estimate the effort they put into the course completion on a five-point Likert-type scale (from 1=minimum effort to 5=maximum effort). Only two students (1.6%) assessed their effort as minimal, and 10.6% considered it very low. Most of the students (44%) stated their effort as medium, and another 44% reported it as high (32.5%) or very high (11.3%).

For the assessment of the students' general satisfaction with some aspects of interactive learning environment implemented within the laboratory exercises of the IT service management course according to the PBL principles, we used a self-created scale similar to the one proposed by (Lin, 2008), consisting of (1) several general questions showing the students' attitude towards the course and the work performed and (2) the semantic differential scale with a five-point Likert-type scale for the assessment of six aspects of the learning environment. The semantic differential scale, a technique for evaluating people on their responses to pairs of bipolar adjectives in relation to concepts, has been found to be

appropriate for the evaluation of experiential teaching methods (Whitney & Soukup, 1988). Different aspects of the learning environment were assessed, using the same semantic differential scale with the following eight pairs of attributes: usual–innovative, boring–interesting, motivating–demotivating, challenging–unchallenging, low quality–high quality, appropriate–inappropriate, unnecessary–necessary and useless–useful. The questionnaire was first piloted in the same course during the 2013–2014 academic year (Pažur Aničić and Mekovec, 2014), when many PBL elements were already implemented.

Table A.1. brings the connection between characteristics of a good PBL problem and their implementation in IT service management course. With the analysis of student satisfaction we wanted to see how satisfied are students with the course implemented according to PBL principles in the following aspects of learning environment:

1) content of laboratory exercises (related to the ITIL v3 concept),
2) teaching methods (teamwork – each team representing a virtual IT company, students given basic instructions only for task completion, the teacher with the role of instructor and only providing guidance to students on their tasks),
3) simulation of work environment (business meeting, contracting and maintenance, assigning roles in the company, determining job vacancies within the company),
4) collaboration with employers (visiting lecturers from several IT companies, practical examples of potential project implementation, presentation of students' final projects in front of company representatives),
5) future career development (insight into the labour market, meeting the standards of the profession – e-CF 3.0., preparation of motivation letter) and
6) Moodle (usage of this LMS to support all course activities).

Students were not expected to evaluate the implementation of certain PBL principle in the course, as it is something they are not familiar with. But they indirectly evaluated it through expressing their satisfaction with six aspects of learning environment which are directly affected with PBL principles. Those aspects refer directly to the implementation of PBL principles, but also stimulate students to think about the connection of this type of learning activities with the world of work and the impact to their future career development.

Table C.1 in Appendix C shows the average values, standard deviation and Cronbach's alpha coefficient for each of the six evaluated aspects of the learning environment. The Cronbach's alpha coefficient for the internal consistency of the scale for each aspect, assessed by eight pairs of attributes, is quite acceptable, ranging from 0.868 to 0.926. Figure 2 shows that the students' assessments of all aspects of the learning environment are on the right, positive side of the semantic differential scale. The students gave the highest ratings to collaboration with employers (M=4.438, sd=0.603) and simulation of the work environment (M=4.137, sd=0.722) in the regular exercises. All the other aspects were rated above average, showing

the students' positive attitudes towards the content of the exercises that were structured in line with the ITIL best practices (M=3.836, sd=0.67), methods used in the teaching process in line with PBL (M=3.776, sd=0.747), activities connected with their future career development and labour market needs according to e-CF 3.0 (M=3.830, sd=0.745), and usage of Moodle to support teaching activities and the students' group work (M=3.640, sd=0.779).

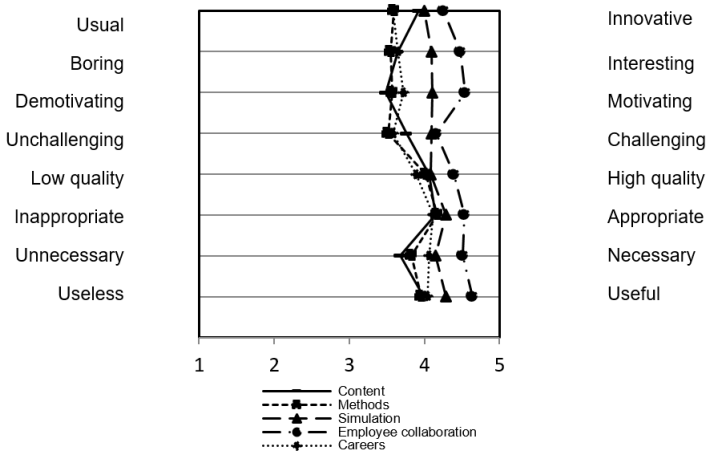

Figure 2. Students' assessment of different course aspects.

To gain better insights into the results, we analysed the effects of the students' initial interest in the course and their efforts in the course completion on the six aspects of the learning environment that were of interest. Table C.2 in Appendix C presents the descriptive statistics for the dependent variables (aspects of the learning environment). Generally, it could be observed that the students with lower initial interest in the course assessed all the course aspects with slightly lower values. The situation was similar with the students who put less effort into performing the course tasks although it was not always the case for the students who rated their efforts 3 points or higher on the five-point Likert-type scale (from 1=minimum effort to 5=maximum effort). To determine if there were statistically significant differences in the effects of the initial course interest and work effort among different groups, we performed the analysis of variance (ANOVA). The test scores indicated no statistically significant differences among the groups regarding the effects of different levels of initial interest and work effort, except in a few cases. There was a significant effect of work effort on the students' assessment of the teaching methods used in the course (df=4, F=3.121, p=0.0179), showing that those who put less effort into the course assignment completion reported lower satisfaction with the teaching methods. Initial interest (df=2, F=15.336, p=1.33e-06) and work effort (df=4, F=3.373, p=0.0121) both showed a significant difference in the students' attitudes towards the aspect of their future career development, indicating that those with lower interest and work effort did not perceive the importance of their future career

at this stage of their study. The students' interest in the course also had a significant effect on their attitudes towards the use of Moodle in the teaching process (df=2, F=5.675, p=0.00451).

Work performance patterns

Besides students' satisfaction with the particular aspects of learning environment set according to PBL principles, another research question is related to the identification of students' work performance patterns in the introduced PBL environment. To identify different groups of students in the set learning environment (in terms of their work performance), the hierarchical clustering algorithm was applied in the statistical package R. Five performance measurement attributes were used (T1, T2, T3, P1 and P2) for clustering, amended with the SA and PA results. The clustering algorithm resulted in seven clusters (C1–C7), as shown in Figure 3, with the descriptive data (mean and standard deviation) in Table B.1 in Appendix B.

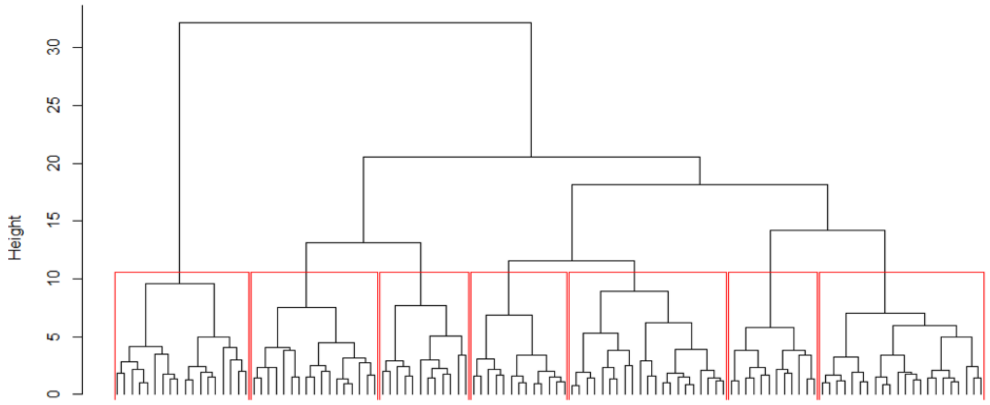

Figure 3. Clusters based on students'work performance.

Cluster 1

Cluster 1 consisted of 18 students with an overall score (M=55.78, sd=5.32) lower than average (M=65.10, sd=9.18). The students included in this cluster had lower performance in individual tests (T1, T2 and T3), as well as project work (P1 and P2) results that were slightly lower than average. Their peers assessed (PA) their project work as lower than average (M=8.67, sd=3.09), but they evaluated their own work (SA) as much higher (M=13.67, sd=2.03) than their peers and teachers did (M=12.06, sd=2.51). Better scores in T3 indicated the students' intention to obtain enough points for a passing (or higher) grade at the end of the semester.

Cluster 2

Cluster 2 comprised 21 students with a lower than average final score (M=60.51, sd=5.75) but higher than that in Cluster 1 (M=55.78, sd=5.32). The students in this cluster obtained lower than average test results in all three tests (T1, T2 and T3), near average project results for the first phase (P1) and above average scores for the final project (P2) phase. These outcomes

indicated that the students in this group were more practically than theoretically oriented, but their general performance was quite low. They seemed aware of the low efforts they put into the course tasks because their SA results (M=13.57, sd=2.50) were lower than those of the PA (M=14.31, sd=1.61) and their P2 grades received from the teachers (M=14.43, sd=3.84).

Cluster 3

In Cluster 3, 12 students obtained a higher than average overall score (M=73.09, sd=6.36). This group's main characteristic was that the students assessed their final project work (SA) with much higher grades (M=18.08, sd=2.53) than those given by their peers (PA) (M=14.88, sd=2.55) and teachers (P2) (M=14.50, sd=2.96). For the members of this group, the negative correlation between the first two tests (T1 and T2) and the project work results (P1 and P2) showed that the students were either practically oriented and thus put more effort into the project work than in the theoretical tests (which would explain their high SA scores) or were assigned to teams in which some members worked more on the project results. Their above average results (M=16.09, sd=1.54) in the last test (T3) indicated their efforts to obtain a better final grade towards the end of the course.

Cluster 4

For the 17 students included in Cluster 4, their overall course score was above average (M=60.57, sd=6.98), and their project work was much better assessed in the second phase (P2). On the other hand, their test results were below average for all three tests (T1, T2 and T3), with very low results in the second test (T2) (M=9.41, sd=2.46). The higher score obtained in the final project phase clearly showed that the students had been working harder on their project in the second phase. However, they seemed unrealistic in the SA of their own work (M=17.94, sd=1.89), which was higher than those obtained from their teachers (P2) (M=15.18, sd=2.46) and peers (PA) (M=16.82, sd=2.51).

Cluster 5

The main characteristic of the 22 students in Cluster 5 was their achievement of higher scores in individual knowledge tests (except T2) than in project teamwork (P1 and P2), which differentiated them from the students in the other six clusters. The SA (M=13.05, sd=1.17) and PA (M=14.09, sd=2.66) of their final project work were similar to their teachers' assessment (P2) (M=13.96, sd=2.17). Of all the clusters, this group's overall course success (M=64.82, sd=5.91) was closest to the average course success for all clusters (M=65.10, sd=9.18).

Cluster 6

Cluster 6 consisted of 13 students with an above average overall score (M=71.58, sd=3.98) and higher scores in project work (P1 and P2) than in individual theoretical knowledge (T1, T2 and T3). The fact that the students evaluated their work (SA) lower than their teachers did

implied that either these students put less effort into teamwork than the other team members did and were aware of it, or they put more effort into project work than the tests and were very self-critical. Both their PA (M=13.50, sd=1.94) and SA (M=15.39, sd=2.76) evaluations were lower than their teachers' (P2) (M=18.23, sd=1.42). It is important to note the really low scores obtained from their peers, which is hard to interpret.

Cluster 7

Cluster 7 included 12 students showing the highest course scores (M=79.10, sd=4.44), with higher than average results for four of the five assessment aspects, except T2, which was slightly below average. From the much lower SA results (M=13.00, sd=3.49), which differed significantly from the PA (M=16.54, sd=2.37) and the teachers' assessment (P2) (M=17.25, sd=2.09), it could be concluded that the students in this group were very self-critical. The possible explanation for this case was that they put more effort into theoretical foundations, not only into project work, giving them a broader theoretical background about the problem they were solving and making them more conscious about possible improvements in their own work.

DISCUSSION AND CONCLUSION

In this paper, we presented a framework for introducing PBL principles in the IT service management course. One of the major changes introduced to the PBL elements in the course is connected with teachers' and students' roles (Roberto & Ribeiro, 2008) in this new form of an interactive learning environment. Teachers are responsible for guiding students in their process of problem solving and therefore assume the role of consultants, as well as facilitators of students' learning. For their part, students are responsible for learning and proposing solutions to the introduced problem. This discussion is organised around several main findings referring to the research questions related to different patterns of the students' work performance and their satisfaction with the introduced learning environment, taking into account this study's limitations.

First, let us discuss the answer to the first research question: *How do students assess particular aspects of this set learning environment, organised according to problem-based learning principles?* The answer to this research question was obtained by the use of semantic differential scale for the assessment of student satisfaction with six course aspects: 1) content of laboratory exercises, 2) teaching methods, 3) simulation of work environment, 4) collaboration with employers, 5) future career development and 6) usage of this LMS Moodle to support all course activities. The general conclusion about the students' satisfaction with the six learning environment aspects, organised according to PBL principles, was found to be very positive. It is interesting to see that students were most satisfied with the collaboration with employers (M=4.438, sd=0.603) and simulation of the work environment (M=4.137,

sd=0.722) within the course, which indicates their positive attitude to the connection with the world of work within regular courses. We can connect our research results of students' satisfaction with certain aspects of learning environment organized according to PBL principles with the positive results of some previous researches on PBL implementation. For example, (Popescu, 2012) showed that, from the students' point of view, PBL contributes to improvements in terms of learning, motivation, enjoyment, involvement, teamwork quality and overall satisfaction but increased their study time and effort compared to traditional learning. This can be related to the significant effect of work effort on the students' assessment of the teaching methods used in our course (df=4, F=3.121, p=0.0179), showing that the students who put less effort into the course assignment completion expressed a lower level of satisfaction with the teaching methods.

Second, within the implementation of the PBL environment, we wanted to research the different patterns in the students' work performance and the SA and PA characteristics through the rubrics in the Moodle workshop. That was researched by the application of cluster analysis and provides an answer to the research question: *Is it possible to identify specific patterns in students' work performance in the established problem-based learning environment?* Cluster analysis resulted in seven different groups of students according to their work performance. Although both teachers and students were introduced to increased time/workload needed for the adaptation to the new learning environment within laboratory exercises organized according to PBL principles, it is noteworthy that the average scores for all three tests (T1=12.56, T2=10.61 and T3=13.53) were lower than those for the project work results (P1=14.72 and P2=15.09). These results indicated the students' positive attitude towards project-based teamwork in solving real-world problems compared to individual theoretical knowledge. As the project-based learning organized according to PBL principles is also based on some theoretical foundations (in this concrete case it is the ITIL v3), it would be interesting to further research if students also better learn and gain theoretical knowledge from this type of activity, comparing to the classical ex-cathedra lectures. If further research shown that this kind of problem-solving teamwork contributes to the development of the necessary skills for the students' future workplaces, both theoretical knowledge and practical skills, it should be considered that the practical part of the course work is weighted with a stronger factor in the course's overall point structure than the strictly theoretical knowledge tests.

Besides providing an answer to the second research question, cluster analysis also provided some insight into the application of student self-assessment and peer-assessment in the courses organized according to PBL principles. The results on the use of SA and PA also indicated different patterns in student behaviour. Although not directly addressed in the research questions of this paper, we will refer shortly to these results as well, since they indicate a potentially interesting area for further research on the assessment within PBL as one of the main curriculum elements described in the theoretical part. In other research studies, using rubrics in the portfolio assessment showed a significant difference between SA

and teacher assessment but no significant difference between SA and PA (Chang, Tseng, & Lou, 2012). Generally, our results found similar values for P2 (M=12.35, sd=3.23) and SA (13.37, sd=2.48), while PA was much lower (M=10.29, sd=2.92) but with differences from cluster to cluster. This confirmed previous findings that PA failed to demonstrate acceptable validity if the teacher assessment was used as a valid exterior criterion (Chang et al., 2012), and it could not be used as a reliable assessment method (Chang, Tseng, Chou, & Chen, 2011). For example, for Clusters 1 and 3, PA was much lower than P2. It can be concluded that PA and SA are recognised as positive and central techniques to develop critical aptitudes in students (Wright, 2011), but they require control from the tutor (Martínez-González & Duffing, 2007). On the other hand, self-evaluation points out two main patterns: 1) students who assess their own work higher than its realistic score, such as in Clusters 1, 3 and 4, and quite the opposite, 2) students who are really self-critical and rate their work much lower in comparison with their comprehensive work performance, similar to those in Cluster 7.
The main limitation in our approach was the anonymous questionnaire with the semantic differential scale, so we were unable to observe the relationships between the students' satisfaction with the set learning environment in line with PBL principles and their work performance. In future research, it would be interesting to find out how students' initial interest and work effort correlate with their work performance. We used the anonymous questionnaire mainly because we wanted to obtain honest responses from the students, which would have been a problematic issue if we had asked them to write their names in the completed questionnaires before they obtained their final course grades.

As for the conclusion, we would like to refer to the introduction, which indicated the importance of the implementation of new teaching methods in courses, in order to better prepare students for the world of work. One of the main roles of higher educational institutions is to educate future professionals in a certain field and to provide them with the knowledge and skills desired by their future employers. The existing literature has shown that the interactive PBL environment offers the possibility to motivate and promote students' awareness and responsibility for their learning, with respect to the development of their professional skills and attitudes. Our work represents a framework for implementing PBL principles into IT service management course that could serve as guidelines for other practitioners willing to implement PBL principles in their courses. The interactive PBL environment positively influences students' self-directed learning and could therefore be used to narrow the gap between the student profiles desired by business organisations and the profiles currently offered by higher educational institutions. Except describing in detail teaching methods organized according to the PBL principles, this study's results contribute to the last phase of the curriculum cycle, the assessment phase, by indicating the potential for the use of self-assessment and peer-assessment methods.

The presented research contributes to several areas of improvement in teaching practices. First, gaining insights into student satisfaction with particular course elements can be helpful

in the further innovation of a particular course or study programme. In this way, students can benefit from modern and creative courses that simulate the actual work environment to solve real-world problems. They can also learn about some techniques to be used in their future professional work. Furthermore, the paper contributes to the individualised approach in course development and delivery, based on the recognition of different students' work performance patterns. When teachers possess information about the patterns in students' work performance in the set learning environment, they can adapt certain course elements to the needs of specific groups of students. This strategy enhances creativity, critical thinking and the development of other transferable and employability skills. Consequently, the results of this research offer valuable inputs in the necessary process of narrowing the gap between current students' skills (developed during education) and the skills desired by employers. Therefore, this study's findings could be used by both researchers and practitioners in their efforts to create or further research a stimulating, interactive learning environment based on PBL that improves the preparation of students for their future workplaces.

Appendix A. Description of PBL elements

Table A.1. Characteristics of a good PBL problem and their implementation in IT service management course.

Characteristic of PBL problem introduced in IT management course	**How was it implemented?**
The problem engages students' interest and motivates them to understand the context of the problem (Duch, 2001; Kolodner et al., 1996)	Organising the course exercises aimed to present students with real-world situations in which they would be active participants. Students attending our faculty and this course would be employed in the information and communication a low grade in technology (ICT) domain. Therefore, new knowledge about the organisation and management of IT companies would be welcomed upon completion of their education process and during their job search. Moreover, students were encouraged to choose a problem according to the teams' previous knowledge and interests to make them more motivated to work on its solution.
The problem requires students to make decisions/judgements based on introduced principles or information (Duch, 2001).	In the beginning of every exercise, students were introduced to the set goals. Furthermore, possible ways of achieving defined goals were presented, and students were requested to consult particular information sources to learn more about how to conduct a particular analysis or compilation, for example. Additionally, during the organised lectures by invited speakers from different IT companies, students were introduced to real problems occurring in such companies on a daily basis or at a particular phase of service development. This was an opportunity to familiarise themselves with the development of services based on presented practice. Consequently, they were able to apply the obtained information in their own virtual companies.
The problem is complex enough that a solution requires the co-operation of all	Owing to the time limitation, the tasks connected to the particular exercises, as well as the overall course goals, were too complex to be solved by one student during a given time period (each exercise

members of the students' teams (Duch, 2001; Kolodner et al., 1996; Weiss, 2003)	lasted for 90 minutes, performed 14 times during the semester). To complete all necessary activities, students were required to communicate within the group and to work as a team.
The problem includes open-ended questions (Duch, 2001); (Kolodner et al., 1996).	During the first week of the semester, the student teams should have agreed on the type of company they would operate and the new IT service they would introduce to the marketplace. For a successful decision, this process required the consensus of all team members. All team members were also expected to be familiar with all the defined processes in their virtual company. Dealing with open-ended questions was most pronounced during the simulation of business meetings with the potential clients, which were organised two times during the semester. The purpose of these meetings was to introduce students to common business communication, as well as to prepare them to different aspects of service presentation. During the meeting, the students played their respective roles in their company and were required to negotiate with a new client about questions from their own domain, without having previously prepared the list of questions to be discussed with a potential client.
The problem is unclear (Lohman, 2002); in some studies, this type of problem is defined yet ill–structured (Baturay & Bay, 2010; Kolodner et al., 1996; Weiss, 2003)	As already mentioned, students were encouraged to choose a problem on their own, and the teachers' role was to judge if the problem would be adequate to satisfy all the learning outcomes of the course. Thus, the problem was not based only on a particular discipline and previously defined. In the beginning of each exercise, students were provided with information regarding the goals of particular exercises, the connection with previous work and the connection with the overall goals of the course. Students were invited to apply their current knowledge, such as implementing a SWOT analysis or defining the graphical standard of a mobile application. They were also introduced to tools, methods and techniques that could be used for performing the exercise tasks and attaining the goals. They were not given a definition of a specific output since there was no ideal solution for each project.
There should be more than one way to solve the problem (Lohman, 2002). The problem should have several interpretation/solutions (Baturay & Bay, 2010; Kolodner et al., 1996)	During each exercise, students were introduced to a new element of service development. Various methods, techniques and tools that could be used to efficiently complete defined tasks were presented. The student teams could choose how they would act and which methods and tools they would use; therefore, various solutions to the same task were possible.
The information provided is incomplete (Lohman, 2002).	During the first business meeting, students presented their ideas on their new IT service to sell it to the potential clients (their teachers). In this negotiating process, the sellers (students) attempted to capture all the client requirements. The clients were demanding various modifications of the presented product/service. Before the meeting, students were informed about its purpose only, but they were unfamiliar with their potential clients' identities and requirements. Moreover, during the meeting, students were required to be very careful about how they would react to client demands because their task in the second cycle of the exercises was to implement and deliver their final service prototype according to what was negotiated.
The connection of previous knowledge to new concepts, as well as new knowledge to the	To solve a particular task, students needed to use their previous knowledge. New concepts, which were expected to be learned through a particular exercise, were referenced on students' previous

concepts in other courses, is mandatory (Duch, 2001; Weiss, 2003)	knowledge, as well as on possible future usage during their graduate studies. For example, students were introduced to the scope of the SWOT analysis during their previous work in other courses, and in this course, they were required to apply the SWOT analysis to their virtual company that was placed in a concrete business environment. On the other hand, the final prototype produced during this course could be used as input for further work in other courses (e.g., mobile application development).
Teachers are only facilitators and consultants; the students' role is to work on the problem (Baturay & Bay, 2010).	Teachers were not using the usual techniques, such as presentations or the conference method, during the exercises, but students were provided with theoretical knowledge during the lectures. Instead, teachers were only giving instructions to students on how a particular task could be solved, and their primary role was to discuss with students about their problems in the company and future steps in their service development. In this manner, teachers assumed the consultant's role for all virtual companies and helped students examine the problem with a more realistic and business view.
Students are motivated towards lifelong and self-directed learning (Weiss, 2003); they evaluate their own work (Baturay & Bay, 2010).	One of the activities carried out during the semester was the analysis of current job offers on the real ICT market. Students had the task of comparing their current knowledge and skills with those recurring in job profiles. In this way, students were motivated to make plans regarding their future professional career. They were also encouraged to assess their own work and compare it to those of their peers through self-assessment and peer-assessment activities.

APPENDIX B: Results of clustering

Table B.1. Descriptive statistics for all clusters

	Overall		**C1 (18)**		**C2 (21)**		**C3 (12)**		**C4 (17)**		**C5 (22)**		**C6 (13)**		**C7 (12)**	
Element	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
T1	12.56	3.49	10.19	2.20	9.74	2.60	14.88	3.57	12.21	2.28	14.36	2.34	11.27	1.90	15.29	2.24
T2	10.61	3.04	7.47	2.67	9.45	1.75	10.71	3.17	9.41	2.46	10.21	1.42	13.39	1.34	13.63	2.60
T3	13.53	3.62	13.73	2.58	12.23	2.02	16.09	1.54	10.84	1.91	14.11	1.42	12.85	1.65	14.85	2.57
P1	14.72	3.21	12.33	3.50	14.67	2.10	16.92	2.63	13.00	3.84	12.18	3.54	15.85	2.91	18.08	1.56
P2	15.09	3.23	12.06	2.51	14.43	3.84	14.50	2.96	15.18	2.46	13.96	2.17	18.23	1.42	17.25	2.09
PA	14.12	2.92	8.67	3.09	14.31	1.61	14.88	2.55	16.82	2.51	14.09	2.66	13.50	1.94	16.54	2.37
SA	14.96	2.48	13.67	2.03	13.57	2.50	18.08	2.53	17.94	1.89	13.05	1.17	15.39	2.76	13.00	3.49
Overall course score	65.10	9.18	55.78	5.32	60.51	5.75	73.09	6.36	60.57	6.98	64.82	5.91	71.58	3.98	79.10	4.44

APPENDIX C: Evaluation of different course aspects

Table C.1. Descriptive statistics of students' satisfaction with different course aspects

	Content		Method		Simulation		Employee		Career		Moodle	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Usual – Innovative	3.992	0.835	3.959	0.936	4.285	0.835	4.642	0.642	4.041	0.872	3.870	0.941
Boring – Interesting	3.683	0.961	3.829	0.894	4.146	0.929	4.512	0.761	4.065	0.894	4.098	0.900
Demotivating – Motivating	4.146	0.856	4.171	0.786	4.285	0.741	4.528	0.631	4.114	0.812	3.992	0.864
Unchallenging – Challenging	4.057	0.771	4.016	0.839	4.081	0.836	4.390	0.785	3.886	0.851	3.829	0.989
Low quality – High quality	3.764	1.064	3.520	1.089	4.098	0.962	4.154	0.984	3.577	0.950	3.407	0.931
Inappropriate - Appropriate	3.488	1.011	3.569	0.933	4.106	0.847	4.545	0.668	3.724	1.011	3.366	1.010
Unnecessary – Necessary	3.642	1.017	3.553	1.026	4.098	0.962	4.480	0.813	3.650	1.008	3.301	1.032
Useless – Useful	3.919	0.845	3.593	1.055	4.000	0.950	4.252	0.874	3.585	0.958	3.260	1.055
Cronbach's Alpha	0.868		0.910		0.926		0.903		0.922		0.921	

Table C.2 Means and SDs of dependent variables

		Interest			Work	
		Mean	**St.Dev**		**Mean**	**St.Dev**
Content	1	3.555	0.428	1	3.063	0.442
	2	3.849	0.658	2	3.596	0.636
	3	3.971	0.790	3	3.734	0.667
				4	4.009	0.613
				5	4.071	0.737
Method	1	3.492	0.543	1	2.625	0.000
	2	3.792	0.751	2	3.490	0.658
	3	3.904	0.820	3	3.757	0.708
				4	3.997	0.701
				5	3.652	0.903
Simulation	1	3.844	0.691	1	3.438	0.088
	2	4.117	0.705	2	4.019	0.775
	3	4.380	0.739	3	4.007	0.747
				4	4.341	0.630
				5	4.268	0.747
Employee	1	4.375	0.631	1	3.563	0.265
	2	4.471	0.521	2	4.625	0.445
	3	4.375	0.811	3	4.317	0.691
				4	4.541	0.528
				5	4.563	0.424
Career	1	3.219	0.693	1	3.375	0.530
	2	3.790	0.675	2	3.663	0.035
	3	4.332	0.675	3	3.727	0.709
				4	4.088	0.629
				5	3.714	0.797
Moodle	1	3.172	0.929	1	3.188	0.619
	2	3.628	0.711	2	3.288	0.979
	3	3.966	0.759	3	3.567	0.681
				4	3.825	0.748
				5	3.786	0.953

Legend: For the variable Interest, 1=small, 2=medium, 3=high
For the variable Work, 1= minimum, 2=very small, 3= medium, 4= high, 5=maximum

References

Ali, A., & Aliyar, L. (2012). Re-engineering of ICT engineering education. In *2012 IEEE International Conference on Engineering Education: Innovative Practices and Future Trends (AICERA)* (pp. 1–6). IEEE. http://doi.org/10.1109/AICERA.2012.6306728

Atfield, G., & Purcell, K. (2010). *Graduate labour market supply and demand: Final year students' perceptions of the skills seek*.

Baturay, M. H., & Bay, O. F. (2010). The effects of problem-based learning on the classroom community perceptions and achievement of web-based education students. *Computers and Education*, *55*(1), 43–52. http://doi.org/10.1016/j.compedu.2009.12.001

Cartlidge, A., Rudd, C., Smith, M., Wigzel, P., Rance, S., Shaw, S., & Wright, T. (2011). *An Introductory Overview of ITIL® 2011*.

Chang, C. C., Tseng, K. H., Chou, P. N., & Chen, Y. H. (2011). Reliability and validity of Web-based portfolio peer assessment: A case study for a senior high school's students taking computer course. *Computers and Education*, *57*(1), 1306–1316. http://doi.org/10.1016/j.compedu.2011.01.014

Chang, C. C., Tseng, K. H., & Lou, S. J. (2012). A comparative analysis of the consistency and difference among teacher-assessment, student self-assessment and peer-assessment in a Web-based portfolio assessment environment for high school students. *Computers and Education*, *58*(1), 303–320. http://doi.org/10.1016/j.compedu.2011.08.005

Chen, C. H. (2010). The implementation and evaluation of a mobile self- and peer-assessment system. *Computers and Education*, *55*(1), 229–236. http://doi.org/10.1016/j.compedu.2010.01.008

Coll, R., Zegward, K., & Hodges, D. (2002). Science and Technology Stakeholders' Ranking of Graduate Competencies Part 2: Students Perspective. *Asia–Pacific Journal of Cooperative Education*, *3*(2002), 35–44. Retrieved from http://www.nzace.ac.nz/wp-content/files/conferences/2002/APJCE_03_2_35_44.pdf

Costley, C., & Dikerdem, M. (2012). *Work Based Learning Pedagogies and Academic Development*.

Domínguez, C., & Jaime, A. (2010). Database design learning: A project-based approach organized through a course management system. *Computers and Education*, *55*(3), 1312–1320. http://doi.org/10.1016/j.compedu.2010.06.001

Draghicescu, L. M., Petrescu, A., Cristea, G. C., Gorghiu, L. M., & Gorghiu, G. (2014). Application of Problem-Based Learning Strategy in Science lessons - Examples of Good Practice, *149*, 297–301. http://doi.org/10.1016/j.sbspro.2014.08.245

Duch, B. J. (2001). *Writing problems for deeper understanding, in The power of problem-based learning: a practical „how to" for teaching undergraduate courses in any discipline*. (D. . Duch, B.J., Groh, S.E., Allen, Ed.). Stylus Publishing LLC.

Ersoy, E., & Başer, N. (2014). The Effects of Problem-based Learning Method in Higher Education on Creative Thinking. *Procedia - Social and Behavioral Sciences*, *116*, 3494–3498. http://doi.org/10.1016/j.sbspro.2014.01.790

European Comitee for Standardization (CEN). (2014). *European e-Competence Framework 3.0*.

Fernandes, S. R. G. (2014). Preparing Graduates for Professional Practice: Findings from a Case Study of Project-based Learning (PBL). *Procedia - Social and Behavioral Sciences*, *139*, 219–226. http://doi.org/10.1016/j.sbspro.2014.08.064

Gareis, K., Hüsing, T., Birov, S., Bludova, I., Schulz, C., & Korte, W. B. (2014). *E-skills for jobs in Europe: Measuring progress and moving ahead*, *Final report*. Bonn, Germany.

Heo, H., Lim, K. Y., & Kim, Y. (2010). Exploratory study on the patterns of online interaction and knowledge co-construction in project-based learning. *Computers and Education*, *55*(3), 1383–1392. http://doi.org/10.1016/j.compedu.2010.06.012

Hung, C.-M., Hwang, G.-J., & Huang, I. (2012). A Project-based Digital Storytelling Approach for Improving Students' Learning Motivation, Problem-Solving Competence and Learning Achievement. *Journal of Educational Technology and Society*, *15*, 368–379.

Hynes, B., Costin, Y., & Birdthistle, N. (2011). Practice-based learning in entrepreneurship education: A means of connecting knowledge producers and users. *Higher Education, Skills and Work-Based Learning*, *1*(1), 16–28. http://doi.org/10.1108/20423891111085366

Intayoad, W. (2014). PBL Framework for Enhancing Software Development Skills: An Empirical Study for Information Technology Students. *Wireless Personal Communications*, *76*(3), 419–433. http://doi.org/10.1007/s11277-014-1715-1

Kolodner, J. L., Hmelo, C. E., & N. Hari, N. (1996). Problem-Based Learning Meets Case-Based Reasoning. In *Proceedings of ICLS 96* (pp. 188–195). Retrieved from http://www.cc.gatech.edu/projects/lbd/pdfs/pblcbr.pdf

Liaw, S. S., & Huang, H. M. (2013). Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Computers and Education*, *60*(1), 14–24. http://doi.org/10.1016/j.compedu.2012.07.015

Lin, Q. (2008). Student satisfactions in four mixed courses in elementary teacher education program. *Internet and Higher Education*, *11*, 53–59. http://doi.org/10.1016/j.iheduc.2007.12.005

Litchfield, A., & Sixsmith, A. (2010). Improving the learning of Graduate Attributes in the Curriculum: a Case-Study in IT Management. In *12th Australasian Computing Education Conference* (Vol. 103, pp. 155–164). Retrieved from http://epress.lib.uts.edu.au/research/handle/10453/16628

Lohman, M. C. (2002). Cultivating Problem-Solving Skills through Problem-Based Approaches to Professional Development. *Human Resource Development Quarterly*, *13*(3), 243–261.

Lokhoff, J., Wegewijs, B., Durkin, K., Wagenaar, R., Gonzales, J., Isaacs, A. K., … Gobbi, M. (2010). *A Tuning Guide to Formulating Degree Programme Profiles* (Vol. 36).

Martínez-González, M. M., & Duffing, G. (2007). Teaching databases in compliance with the European dimension of higher education: Best practices for better competences. *Education and Information Technologies*, *12*, 211–228. http://doi.org/10.1007/s10639-007-9047-3

Matsuo, M., Wong, C. W. Y., & Lai, K. (2008). Experience-based learning of Japanese IT professionals: A qualitative research. *The Journal of Strategic Information Systems*, *17*(3), 202–213. http://doi.org/10.1016/j.jsis.2008.03.001

McKimm, J. (2007). *Curriculum design and development*. Retrieved from http://www.faculty.londondeanery.ac.uk/e-learning/setting-learning-objectives/Curriculum_design_and_development.pdf

Mourshed, M., Patel, J., & Suder, K. (2013). *Education to Employment: Getting Europe's Youth into Work*.

Musa, F., Mufti, N., Latiff, R. A., & Amin, M. M. (2011). Project-based learning: Promoting meaningful language learning for workplace skills. *Procedia - Social and Behavioral Sciences*, *18*, 187–195. http://doi.org/10.1016/j.sbspro.2011.05.027

Musa, F., Mufti, N., Latiff, R. A., & Amin, M. M. (2012). Project-based Learning (PjBL): Inculcating Soft Skills in 21st Century Workplace. *Procedia - Social and Behavioral Sciences*, *59*(2006), 565–573. http://doi.org/10.1016/j.sbspro.2012.09.315

Pažur Aničić, Katarina, and Renata Mekovec. 2014. Case Study of Implementing Work Based Learning in IT Menagement Service Course. In *EDEN 2014 Annual Conference, Zagreb, Croatia: E-Learning at Work and the Workplace - From Education to Employment and Meaningful Work with ICTs*.

Pilgrim, C. J. (2013). Industry involvement in ICT curriculum: A comparative survey. In *2013 35th International Conference on Software Engineering (ICSE)* (pp. 1148–1153). IEEE. http://doi.org/10.1109/ICSE.2013.6606666

Popescu, E. (2012). Project-based learning with eMUSE: An experience report. *Lecture Notes in Computer Science (including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 7558 LNCS*, 41–50. http://doi.org/10.1007/978-3-642-33642-3_5

Roberto, L., & Ribeiro, D. C. (2008). Electrical engineering students evaluate problem-based learning (PBL). *International Journal of Electrical Engineering Education*, *45*(2), 152–161.

Şendağ, S., & Ferhan Odabaşı, H. (2009). Effects of an online problem based learning course on content knowledge acquisition and critical thinking skills. *Computers & Education*, *53*, 132–141. http://doi.org/10.1016/j.compedu.2009.01.008

Shukla, N., Costley, C., & Inceoglu, I. (2011). *Work-based learners' engagement with the university: An exploratory study*. Retrieved from http://eprints.ioe.ac.uk/16368/

Weiss, R. E. (2003). Designing problems to promote higher-order thinking. *New Directions for Teaching and Learning*, *2003*(95), 25–32. http://doi.org/10.1002/tl.109

Whitney, G., & Soukup, W. (1988). A SEMANTIC DIFFERENTIAL INSTRUMENT TO EVALUATE EXPERIENTIAL TEACHING METHODS. *Developments in Business Simulation & Experiential Exercises*, *15*, 183–187.

Wright, G. B. (2011). Student-Centered Learning in Higher Education. *International Journal of Teaching and Learning in Higher Education*, *23*(3), 92–97. http://doi.org/10.1080/03075079312331382498

Yu, F. Y., & Wu, C. P. (2011). Different identity revelation modes in an online peer-assessment learning environment: Effects on perceptions toward assessors, classroom climate and learning activities. *Computers and Education*, *57*(3), 2167–2177. http://doi.org/10.1016/j.compedu.2011.05.012

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 38-52
http://dx.doi.org/10.5278/ojs.jpblhe.v4i1.1451

PBL and the Postmodern Condition - Knowledge Production in University Education

Ole Ravn, Annie Aarup Jensen *

ABSTRACT

In this article we discuss the contemporary conditions for running the Aalborg Problem Based Learning-model (PBL). We try to pinpoint key characteristics of these conditions emphasising Lyotard's conception of knowledge production referred to as the move towards a postmodern condition for knowledge. Through discussions of this alleged condition for university curricula development we investigate its connections to the PBL-model. Some of the explored conditions highlight strong potentials for the PBL-model as an educational setting.

INTRODUCTION

A defining aspect of Aalborg University is its emphasis on the Problem Based Learning-model (PBL) as a pedagogical tool for learning activities across all of its faculties. However, the PBL-model stems from the 1970's and it is increasingly important to investigate whether its original theoretical grounding is still relevant as new agendas emerge in relation to the ongoing development of university education. These new agendas – some of political origin and others stemming from changes in the production of knowledge at the university and in society in general – call for a discussion of the potentials in and the challenges to the PBL-

* Ole Ravn, Aalborg University, Department of Learning and Philosophy.
E-mail: orc@learning.aau.dk
Annie Aarup Jensen, Aalborg University, Department of Learning and Philosophy.
E-mail: aaj@learning.aau.dk

model. Is PBL a worthwhile institutional model for university curricula or is it just an interesting but rather outdated educational model that belonged to the idealistic days in the aftermath of 1968?

In 1974 Aalborg University came into being and from the outset posed a challenge to the traditional universities in Copenhagen, Århus and Odense. Two years previously, in 1972, Roskilde University Centre had been established based on many of the same intentions and ideas as those developed in Aalborg.

As a fundamental pedagogical tool these two new universities used Problem Based Learning as a backbone of the curriculum. This idea of taking the outset in real life problems rested on the argument that the societal development demanded a new and more complex set of qualifications in the workforce, as it was suggested by Illeris in his ground breaking book on problem orientation[i] and participant direction in 1974 (Illeris, 1974). From his analysis of the educational system and its function in a society where technology and automatization would play an increasing role, Illeris concluded that society needed a holistic learning model which could lead to the development of the following three categories of qualifications: skills, adaptability (acceptance of the norms and values of the existing society) and creativity (independence, interpersonal skills, and critical sense). The need for general qualifications and the interaction with practice[ii] which is integrated in the model called for a transgression of the traditional subject boundaries in order to promote the students' perception of coherence and connection. Interdisciplinarity thus became a pivotal point in the original model of problem oriented learning. In addition to the problem oriented learning approach, educations were organised in groups of students studying and researching their chosen problem together, writing up the project report together, and finally presenting and evaluating the product together. The model thus had a strong focus on developing the interpersonal skills necessary for cooperation and in that perspective competition among students was considered inappropriate and even counterproductive.

This was – briefly – the original inspiration for what has been termed the PBL-model at Aalborg University[iii]. The PBL-method is today carried out in a number of slightly different variants at Aalborg University, but Illeris can be said to have described the original idea of the PBL model.

In this article we will discuss how the conditions for working with the PBL-model as an integrated part of the university curricula can be conceptualised and interpreted. As described it was developed in a certain period of political changes but this atmosphere of political change has disappeared a long time ago and the questions as to why the PBL-model is a valued part of university educations and why it is a proper model to implement in universities cannot only hinge on its development in the past.

Many studies have discussed the benefits of the PBL-model in relation to specific issues like the changed role of educators, the student led projects, the impact of group work etc. in order to highlight the characteristics of the PBL-model. Here, however, our aim is to focus on the changes in the way knowledge production at universities has been perceived in the modern era as opposed to the postmodern era - a term we will follow Lyotard in using when referring to the contemporary status and conditions for producing knowledge. By following this special interest our initial problem statement could be phrased in the following way:
How can we understand the relation between PBL and the conditions for knowledge production within a postmodern framework?

Our approach to answer this question hinges on our ability to pinpoint important aspects of the conditions for running university education. To support our considerations on this issue we choose – as mentioned – to pay closer attention to Lyotard's conception of a postmodern condition for knowledge production and we attempt to highlight what this condition could entail for the way we conceive of the PBL-model. Lyotard thereby functions as an inspirational source for reflecting upon the educational principles of the PBL-model.

Many other perspectives could be relevant for discussions on the conditions for university educations. Lyotard's approach brings a strong historical and philosophical dimension into our conceptualisation of the conditions for running university educations and in our view it supplements other more recent approaches. We have found inspiration in Lyotard's narrative approach and its development out of an explicitly Wittgensteinian language game perspective to be a special approach in producing thoughts about the conditions for legitimizing university educations. We find this approach to be both historically important and an indispensable resource and reference point to bring forward for understanding PBL in the debates on universities today.

Following our investigation of Lyotard's vocabulary we will describe some key features of the PBL-model at Aalborg University in order to define the PBL educational principles in more detail. Based on these insights we will discuss the problem formulation.

In following this approach in an answer to the problem statement we do not aim to establish a coherence between the chosen perspectives and theories and the PBL-model as it works in practice at Aalborg University. Instead we aim to develop and construct a conceptualisation of the condition for running a PBL-model that can enlighten our perception of its foundation as an educational model.

Also, we are not engaging a project of arguing in favour of or rejecting the PBL-model as a future model for university education. Rather, we aim to draw attention to the basic conditions that drives the PBL-model in university educations. By doing so we hope to spark discussions

on the PBL-model and create a space for reflecting upon the model today more than 40 years after its origin.

A REPORT ON KNOWLEDGE

The knowledge society of today demands specific types of skills. "Innovation" and "innovative skills" are buzz words and individuals with the ability to work effectively in teams and creatively in a complex reality are highly sought after. The same is the case with individuals having skills in entrepreneurship and who are able to open up new niches for economic growth. This means that university educations' interaction with society has changed significantly and the global economy has a strong impact on the way research and education is conducted. In light of these developments we have found it interesting and necessary to search for theoretical approaches that attempt to describe and conceive of the outlined relationship between university educations and the surrounding society.

Some theoretical perspectives on this situation suggest that the organisation and structures of knowledge in so-called highly developed societies are moving in new directions and as a result the university considered as an organiser of knowledge has faced serious challenges not only with regard to its knowledge production but also in relation to the structuring of educational programmes. As far back as in 1979 Jean-François Lyotard termed the dramatic changes undergoing the status of knowledge in highly developed societies "the postmodern condition". Here we refer to his essay from 1979 *The Postmodern Condition: A Report on Knowledge*, which brought him fame outside France and made him a renowned philosopher around the globe. Part of his analysis dealt with the shift from a classical Humboldian organisation of knowledge and university educations to a new era where "new moves" and performance criteria would be key ideas for understanding the concept of knowledge and its impact on university educations. We pay special attention to Lyotard's analysis in relation to university educations like many other authors before us (see for example Peters, 1995; Brügger, 2001). We are especially interested in what Lyotard's idea about a postmodern condition for university educations entails for our understanding of running the PBL-model today.

In *The Postmodern Condition*, which was requested by and presented to the Conseil des Universitiés of the government of Quebec, Lyotard describes a move away from the modern era. The modern worldview is transforming into a postmodern framework of understanding and perceiving the world and this is intimately linked to the status of knowledge. The development towards postmodernity is described as a transition in the attitude towards certain meta-narratives about knowledge. In modernity these meta-narratives were used to legitimise doing science and producing knowledge in a particular way, whereas postmodernity is defined as a way of thinking where these meta-narratives are rejected or 'tranquilated' as

Lyotard likes to depict their diffusion (Lyotard, 1992, p. 18). Here we shall not in detail follow Lyotard's line of reasoning for arguing that the status of knowledge in highly developed societies is undergoing radical change but merely adopt his general insights on the issue[iv].

According to Lyotard we have witnessed a gradual historical change from science in modernity being first and foremost legitimised by two grand narratives either emphasising the encyclopaedic nature of knowledge (emphasising the search for truth through science) or the emancipative nature of knowledge (emphasising the search for justice through science) to being legitimized locally through its performativity. The narrative of performativity can easily be connected to a number of small narratives in different ways and works as an effective narrative in singling out those research projects, which are immediately useful from a societal or economic perspective. The consequence of the rejection of 'grand narratives' has not been the total rejection of encyclopaedic and emancipative legitimation strategies for research projects and sciences in general. But these strategies can no longer be taken for granted, and they are reduced to little narratives that function in sub-domains and – of great importance to our task at hand – are not strong enough to function as organising principles for the research at a university or for supporting the foundation for a university education.

In Lyotard's postmodern framework, scientific activities are being subordinated the technical criteria of efficiency and performativity. Scientific development is therefore governed by research results' ability to perform and Lyotard underlines that research that does not explicitly aim at bettering the system's overall performance will not survive.

> "*Research sectors that are unable to argue that they contribute even indirectly to the optimization of the system's performance are abandoned by the flow of capital and doomed to senescence. The criterion of performance is explicitly invoked by the authorities to justify their refusal to subsidize certain research centres.*" (Lyotard, 1979, p. 47)

In other words a specific discourse on legitimating science has taken control and it is a discourse, which cherishes efficiency. This new quest for efficiency negates the encyclopaedic tendency towards the 'science for its own sake' dictum, as the technological criterion entangles any scientific work in a practical setting (in a company, in a grassroots organisation, in a university context, in a political decision making process etc.). And the quest for efficiency equally negates the idea that science emancipates the whole of humanity from social or natural suppression, as the arguments that are forceful in legitimating one research project over others concern what is efficient for the (economic) system's performance and not what is just.

What does the performativity criterion entail for the changes we face in thinking about university educations? Lyotard had only a preliminary glimpse of these issues back in 1979 but his conclusions seem to us to be highly relevant for the dominating issues of today's educational debates. We will present four issues – inspired by Lyotard – that could be thought of as inescapable parts of a postmodern condition for university educations.

Issue 1: The fields of study become increasingly interdisciplinary.

Some of the changes that Lyotard observes in university education deal with the decline of the Humboldian idea about a university with a well organised encyclopaedic ordering of the sciences. In contrast to the classical ordering of things in a Humboldian university new fields of research are continually invented and explored and parallel to this development new educations spring in yet unseen numbers often threatening the classical educations by attracting students to the new educational options. As an example many new interdisciplinary educations have been developed at Aalborg University within the last decade; Techno-anthropology, Product and Design Psychology, Learning and Innovative Change, to name a few, and on top of these one could mention the already "normalised" new moves in the landscape of science on a world wide scale in the form of Nanoscience, Biotechnology, Health technology, and Robotics that are all the product of interdisciplinary studies.

Under these conditions the ability to connect spheres of data previously disconnected by the traditional disciplinary organisation of the Humboldian University becomes a key issue in university education. Lyotard asserts that it will be part of the educational effort to

> "*…include training in all of the procedures that can increase one's ability to connect the fields jealously guarded from one another by the traditional organization of knowledge. […] In Humboldt's model of the University, each science has its own place in a system crowned by speculation.*" (Lyotard, 1979, p. 52)

In Lyotard's conception of the relation between the sciences it no longer serves any purpose to make students in interdisciplinary study programmes familiar with a basic core of knowledge in the classical sciences. The idea that the stable knowledge of the classical disciplines should be more basic than other fields of knowledge hinges on an encyclopaedic Humboldian narrative of science. As a consequence, we can state a second issue of the postmodern condition for university education curricula.

Issue 2: The idea of being informed about a tradition of knowledge (transferral of information) loses terrain to the idea of nurturing the capability of producing knowledge (development of research capabilities).

What seems natural in the postmodern state of science is, in Lyotard's view, the capacity to actualize an efficient strategy in a particular context – i.e. to solve a problem efficiently.

> "*It should be noted, however, that didactics does not simply consist in the transmission of information; and competence, even when defined as a performance skill, does not simply reduce to having a good memory for data or having easy access to a computer. It is a commonplace that what is of the utmost importance is the capacity to actualize the relevant data for solving a problem "here and now," and to organize that data into an efficient strategy.*" (Lyotard, 1979, p. 51)

Lyotard here points to several aspects of Issue 2. Because of the dominance of the technological criterion of performativity there is the need for making students able to solve specific problems efficiently in contrast to first and foremost letting them receive general information. Focusing on solving problems inherently brings with it certain directions for the educational content. The content is directed towards the contextualisation of a problem, that is, it is connected closely to a real existing practical setting. The problem is a "real life"-problem which means that it is a problem for somebody to have produced for them a strategy for making decisions etc.

The above considerations already contain a third issue of the postmodern condition with direct implications for the university education, namely the idea that information is becoming increasingly attainable. There is more than enough data and information under the postmodern condition. Lyotard speaks of this situation as 'perfect information' as opposed to a situation where you (for example the teacher) have the upper hand in the game by having access to more information than the other players (for example the students). Instead, Lyotard proposes that what students need to have nurtured is imagination!

Issue 3: Imagination becomes a key competence in the perfect information situation.

Lyotard comments on "the perfect information game" in the following paragraph from a point in history where he has no clear idea about the Internet or the massive development in our everyday access to information, research articles, big data etc.

> "*But in games of perfection, the best performativity cannot consist in obtaining additional information in this way. It comes rather from arranging the data in a new way, which is what constitutes a "move" properly speaking. […] It is possible to conceive the world of postmodern knowledge as governed by a game of perfect*

> *information, in the sense that data is in principle accessible to any expert: there is no scientific secret. […] what extra performativity depends on in the final analysis is "imagination," which allows one either to make a new move or change the rules of the game.*" (Lyotard, 1979, p. 52)

Lyotard points to the need for fostering "imagination" in students as an important part of the curriculum. If students learn how to be imaginative they stand a chance of succeeding in handling the interdisciplinary solution strategies to contextualised practical problems. They do need information as part of their curricula but it will not necessarily add to their performativity. Instead, their capability in localising and addressing the right information and bringing it into the particular setting of a unique problem is what matters and this process demands imagination.

This naturally has implications for the role of the agents in university studies – the teachers and the students.

Issue 4: The roles of the agents in university educations change

Under these settings teachers cannot first and foremost be engines for transferring information but rather for teaching students, through the teacher's own experience with doing research, how one can imagine different efficient strategies for solving a specific and contextualised problem. Under the postmodern condition the role of the teacher changes just as dramatically as the disciplinary organisation. In the perfect information situation, the authority of the individual scholar will be challenged by the superior imagination of interdisciplinary teams. In Lyotard's conception the move towards teamwork is a consequence of the effectiveness of working in teams but also of the changes in the status of knowledge:

> "*The emphasis placed on teamwork is related to the predominance of the performativity criterion in knowledge. When it comes to speaking the truth or prescribing justice, numbers are meaningless. They only make a difference if justice and truth are thought of in terms of the probability of success. In general, teamwork does in fact improve performance, if it is done under certain conditions detailed long ago by social scientists.*" (Lyotard, 1979, pp. 52-3)

> "*But one thing that seems certain is that […] the process of delegitimation and the predominance of the performance criterion are sounding the kneel of the age of the Professor: a professor is no more competent than memory bank networks in transmitting established knowledge, no more competent than interdisciplinary teams in imagining new moves or new games.*" (Lyotard, 1979, p. 53)

The role of the educator cannot consist in only distributing information about a tradition of what is considered bullet proof knowledge within a given discipline. This was the original task of "the professor". Lyotard's conclusion is that the best performance in knowledge production is achieved through teamwork. He indirectly discusses what it means to be fostering imaginative thinking in university education making students capable of making interdisciplinary connections between fields of study and learning how to manage and solve specific contextual problems in teams that no one has ever posed before.

Lyotard's ideas are broad and general and to some extent even prophetic in nature as they were created more than 30 years ago. However, it seems clear that he has pinpointed several issues that are essential to the conditions for contemporary university education. Some of these conditions are the demand for knowledge that can lead to immediate performance in an efficient manner; the fact that there is a perfect information game situation; that the Humboldian structuring of knowledge and university is withering etc. These basic conditions for all knowledge production, according to Lyotard, raises a range of issues for university educations as we have outlined above: 1) the importance of being able to handle interdisciplinary studies; 2) the importance of teaching the ability to actualize relevant data for solving problems here and now and propose efficient strategies in relation to these problems; 3) the importance of nurturing the imagination of students; and 4) the importance of reinterpreting the role of the agents in university educations.

Drawing from Lyotard's analysis on the status of knowledge in highly developed societies these are in our view four key characteristics of the changed condition for thinking about university educations that are dominant today.

THE PBL-MODEL AND THE CONDITION

We set out to discuss the conditions for running a PBL-model in university educations. So far we have followed and interpreted Lyotard's conceptualisation of a postmodern condition for knowledge production and developed some key characteristics of this condition for university educations. Many other conceptualisations of the conditions for university educations could of course be found and developed relating to other authors and theories but as explained above we find that Lyotard's approach is both historically and conceptually interesting as a complement to contemporary outlines of conditions for university educations.

In the following we will attempt to relate the characteristics developed in Section 2 to the PBL-model in higher education. We do this by way of a specific example of a PBL-model in present use, namely by outlining the key principles of the PBL-model in the form it has developed into at Aalborg University as expressed by the university's official guiding principles. Following this outline, we will discuss how we can relate the developed

vocabulary to more recent approaches and where this leaves the PBL-model in the light of the postmodern condition.

In the 2015 university information material about the principles of Problem Based Learning (AAU, 2015) the basic principles of the model is outlined. As a general introduction the idea is presented that the work with an authentic problem is the ideal learning situation for students.

> "*The Aalborg model assumes that students learn best when applying theory and research based knowledge in their work with an authentic problem. At the same time, the model supports students in the development of their communication and cooperation competences, and in acquiring the skills required when taking an analytical and result-oriented approach.*"

Adding to this, the idea is presented that problems worked on should be relevant from a position outside the university.

> "*'Authenticity' implies that the problem is of relevance outside of academia. 'Scientifically based' implies that the problem is comprehensible and may be analysed and solved, taking an interdisciplinary approach.*"

In this way it is also highlighted that the problems to be worked on by students are interdisciplinary as a result of their origin in the authentic setting or context. In addition to these fundamental perspectives about the problems to be worked on other basic principles in the PBL-model are listed as follows:

- Project organisation creates the framework of problem-based learning
- Courses support the project work
- The problem-based project work of the groups must be exemplary
- Cooperation is a driving force in problem-based project work

Going into the last basic principle, the group work is identified as the main centre for the development and negotiation of the project.

> "*A group of students work closely together in managing and completing a project over an extended period of time, taking a problem as the point of departure for their work. The students' mutual support is essential for the successful completion of the project. The group work includes aspects such as knowledge sharing, collective decision-making, academic discussions, action coordination and mutual critical feedback. Student groups also engage in close cooperation with their supervisor(s) and with external partners, e.g. businesses or other project groups.*"

Let us now consider these principles in relation to the characteristics of the postmodern condition developed above. As is obvious from the outline of the general PBL principles used at Aalborg University the postmodern condition points towards several aspects of problem based learning.
On the basis of the above expositions let us highlight some of the connections between on the one hand the postmodern condition for knowledge production as described above and on the other hand the PBL-model as an educational setting.

Firstly, in relation to issues 2) the movement towards knowledge production and problem solving and 4) the importance of teams in relation to the performativity criterion, there is a strong connection relating to an educational model that can open a space for training students in solving authentic problems. This is in contrast to a university educational environment where the main function of teaching is the verbal presentation of information and knowledge through course activities where the teacher is the most active participant in the learning processes and where students individually study the tradition of and literature in the field. The PBL-model offers the possibility of training students academically in the skills associated with solving an open-ended problem that has no obvious solution and students will be able to do this with support from a university teacher (contributing first and foremost with her research skills) that acts as a supervisor for a group of students.

In this way the most relevant experiences of the teacher can benefit students, namely the teacher's skills as an imaginative researcher and not only as a memory bank of what is the traditional knowledge in the field of study recalling Lyotard's ideas. Hence, the PBL-model is tightly related to the postmodern condition in its insistence on furthering the problem solving competencies of students within a group of students working in collaboration on a particular problem and producing project reports through the close cooperation between students' project processes and the teacher's knowledge about doing research. In the PBL-model the role of the teacher is decisively transformed in the direction of a supervisor for supporting the project work and only partly as a lecturer.

Another issue of the described postmodern condition for knowledge production that is addressed through the PBL-model is the possibility of working with problems that are interdisciplinary in character, Issue 1. This is as pointed out directly addressed in the Aalborg University PBL guide lines and even considered one of the identifying characteristics of problem based learning as it was originally conceived of by for example Illeris (1974). Many real life problems that researchers must deal with do not fit the Humboldian division of the sciences and therefore the PBL-model's ability to cope with this problem can be essential. In the guidelines for PBL at Aalborg University the importance of furthering interdisciplinary approaches is highlighted several places and can be considered as a clear connection point to characteristics of working under a postmodern condition for knowledge production.

The fourth point developed above from Lyotard's conception relates to the idea of 3) the importance of nurturing the imagination of students. This element is not directly highlighted in the PBL guide lines from Aalborg University and a connection can therefore only be intermediate on this issue. It is clear from the guide lines that students are encouraged to "create synergies between different cooperation cultures by collaborating with external partners and engage in interdisciplinary learning environments" but 'imagination' or even 'innovation' are not part of the description of the PBL-model.

DISCUSSIONS

It seems fair to conclude that the PBL-model can be interpreted as an answer to tackling the technological criterion and the perfect information situation as they have been described by Lyotard as characteristics of the postmodern condition for running university educations. By focusing on interdisciplinarity, problem solving, efficient and imaginative solution strategies as well as the organisation of studies in project groups in dialogue with supervisors and external partners the PBL-model matches the outlined postmodern condition for university educations.

As an answer to the problem statement of this article it is quite easy to conclude that the conceptualisation provided by the Lyotardian framework about a postmodern condition for knowledge production and its impact on university educations positions the PBL-model as an obvious choice for an educational setup. In the final discussion of the paper we will reflect on where this leaves the PBL model and how other perspectives supplement and expands on Lyotard's framework.

If we turn to more recent statements on the demands on education and knowledge production, Hargreaves provides a detailed description of the complexity of society's need for knowledge and skills, and refrains several of the Lyotard inspired aspects developed above.

> "…the ability to integrate formal and informal learning, declarative knowledge (or *knowing that*) and procedural knowledge or (*know-how*); the ability to access, select and evaluate knowledge in an information soaked world; the ability to develop and apply several forms of intelligence as suggested by Howard Gardner and others; the ability to work and learn effectively and in teams; the ability to create, transpose and transfer knowledge; the ability to cope with ambiguous situations, unpredictable problems and unforeseeable circumstances;… (Hargreaves 2000)"

Going back to Lyotard, these abilities clearly relate to the demand in the described postmodern condition of adapting to the technological criterion of performativity – of being able to work and create on unpredictable problems in a world of too much information.
It points towards the need for students to be working on problems that are real world problems but here the postmodern condition highlights a demand for projects to be worthwhile even in an economical sense. The ability to work efficiently under the technological criterion includes being immediately able to answer to legitimisation questions like; Why is this research/student project necessary?; What can it be used for?; Will it pay off?

The postmodern condition is therefore also related to 'knowledge production in a market perspective' (Bøgelund & Kolmos, 2013). Recent research in knowledge production in higher education has identified three perspectives on knowledge production co-existing in a PBL context: 1) an Academic perspective, i.e. knowledge as true, well founded conviction and knowledge production as important, 2) a Market perspective, i.e. the application of knowledge as important, 3) a Society changing perspective, i.e. knowledge as a source of empowerment and change; value-based, contextual knowledge exchange as important (Ibid). Lyotard's analysis is clearly revisited in these categories and the postmodern condition underlines the growing primacy and turn towards the market perspective.

Lyotard discusses the postmodern condition with some pessimism on the count of this but it is clear that no matter how one feels about the transformation of knowledge as such towards being less occupied with truth and human emancipation but rather with efficiency and performativity, it does not change the fact that the PBL-model can be an excellent educational model for furthering performativity in students. In fact, even when considering the PBL-model in the perspective of Barnett's claims for an epistemology of uncertainty to govern the knowledge production at the university in an age of supercomplexity (Barnett, 2000), we find that the PBL-model to a large extent will be able to deliver. The demands are

> "1) The capacity for revolutionary reframing;
> 2) The capacity for critical interrogation of all claimants for knowledge and understanding;
> 3) The capacity for enabling individuals to feel at ease in an uncertain world;
> 4) The capacity for developing powers of critical action." (Ibid: 420)

Lyotard would have rejoiced these capacities in the sense that he advocated strongly for what he referred to as paralogical thinking in *A Report on Knowledge*. His fear was a centralised control system of research for (believed) economic growth and his hope was to make research and university educations thrive in a process of paralogical developments – against the systematic or normal – ways of producing knowledge. PBL in our perception has the potential to not only be the economically efficient model under a postmodern condition but also has the

potential of producing paralogical approaches in university education with its student driven multiplicity of knowledge productions for potentially each project that is started.

An interesting paradox at this stage is, however, that despite the obvious connections between performative knowledge, marketization and the PBL-model it is still thought of by many as an experimenting and progressive university education model and thereby challenging the traditional university educations. From the conceptualisation we have developed here it could almost seem like a mainstream educational model that directly meets all the wishes of politicians and industry for providing a university that is more integrated in the knowledge economy. So why not go all in on PBL?

There are many more conditions for the PBL-model at stake than those referred to in this article and they have to be accounted for as well, to give a fuller picture of the status of the PBL-model's future in university education. That, however, is a task for further studies and we have here only suggested that the postmodern condition for knowledge production can make a good starting point for producing this fuller picture.

References

Barnett, R. (2000). University knowledge in an age of supercomplexity. *Higher Education,* 40, 409-422), 2000.

Bøgelund, P. & Kolmos, A. (2013). Ph.d.-vejledning i et akademisk, markedsdrevet og samfundsforandrende perspektiv. *Dansk Universitetspædagogisk Tidsskrift*, årgang 8, nr. 15, 2013.

Brügger, N. (2001). What about the Postmodern? The Concept of the Postmodern in the Work of Lyotard. *Yale French Studies*, No. 99, Jean-Francois Lyotard: Time and Judgment, pp. 77-92.

Christensen, O. R. & Børsen, T. (2009). From Anomaly to Paralogy – The Post-modern Condition and its Consequences for University Science Education. In *University Science and Mathematics Education in Transition* pp. 283-299. Ed. Ole Skovsmose; Paola Valero; Ole Ravn Christensen. Springer, New York.

Hargreaves, D. (2000). *Knowledge management in the learning society*. CERI, OECD. Paris: The Organisation.

Illeris, K. (1974). *Problemorientering og deltagerstyring. Oplæg til en alternativ didaktik.* Munksgaard, Copenhagen.

Kolmos, A., Fink, F. & Krogh, L. (eds.) (2004). *The Aalborg PBL-Model – Progress, Diversity and Challenges*. Aalborg University Press.

Lyotard, J. F. (2004). *The Postmodern Condition: A Report on Knowledge*. Manchester University Press.

Peters, M. (1995). Education and the Postmodern Condition: revisiting Jean-François Lyotard. *Journal of Philosophy of Education, Vol. 29, No. 3.*

Aarup Jensen, A. & Bækkelund Jensen, H. (2004). Back to the Future- theory and practice in adult prractitioners' problem oriented project work. In Anette Kolmos, Flemming K. Fink, Lone Krogh (2004). *The Aalborg PBL model. Progress, Diversity and Challenges.* Pp. 285-302. Aalborg University Press.

AAU PBL Principles:
Retrieved on this address on 10th of March 2016:
http://www.aau.dk/digitalAssets/62/62747_problem_based_learning_aalborg_university.pdf

[i] A distinction can be made between 'problem oriented' and 'problem based' learning – in this article we use the two concepts synonymously. For a discussion of the difference between PBL and problem oriented learning see Aarup Jensen and Bækkelund Jensen, 2004.

[ii] Such as industry and trade, i.e. the students' future workplaces.

[iii] For a more detailed presentation and discussion of the Aalborg PBL-model see (Kolmos et. al., 2004).

[iv] For a more thorough account of Lyotard's report on the status knowledge see (Christensen and Hansen, 2009).

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 53-70
http://dx.doi.org/10.5278/ojs.jpblhe.v4i1.1554

Dealing with Insecurity in Problem Oriented Learning Approaches - The Importance of Problem Formulation

Annie Aarup Jensen, Birthe Lund *

ABSTRACT

Introduction of a pedagogical concept, Kubus, in a problem oriented learning context – analysed within the framework of an activity system – indicates what might happen when offering tools tempting to influence and regulate students' learning approach and hereby neglecting the importance of existing habits and values. Introduction of this new approach challenges existing "truisms ". It implies a reconsideration of the role of insecurity and how it is connected to questioning the given thus supporting development of new knowledge. However, dealing with insecurity seems to be a neglected area within a problem oriented learning approach.

INTRODUCTION

Knowledge creation, invention and the ability to handle risk are often linked to entrepreneurial and innovative pedagogy and the concept *of transformative learning* (Engeström & Sannino, 2010). Besides learning about a subject, students in general are expected to develop competences such as the ability to collaborate, share knowledge, be focused, committed, innovative, creative etc. when the intention is to transform students into self-directed and active *knowledge creators as well as problem solvers* (Lund 2017). Problem oriented learning in complex situations is highly dependent on knowledge sharing and problem framing. In self-directed group work, students ideally negotiate, discuss and challenge each other's framing of the research question. Students' handling of this situation is

* Annie Aarup Jensen, Aalborg University, Department of Learning and Philosophy.
E-mail: aaj@learning.aau.dk
Birthe Lund, Aalborg University, Department of Learning and Philosophy.
E-mail: bl@learning.aau.dk

consequently important. Students are expected to be persistent and stay in this insecure process in order to develop their ability to judge the usefulness of ideas and knowledge, by investigating and arguing. Hence students are exposed to complexity and insecurity. We argue that dealing with insecurity is a fundamental aspect of students' potential for learning and development of innovative and creative skills. Consequently, pedagogical framing of this is important. We regard this a neglected pedagogical challenge within a problem oriented learning approach. Based on this we raise the question:

"How to deal with insecurity in problem oriented learning approaches?"

We address this question within the framework of problem based group organised learning setting at Aalborg University and we are inspired by Knud Illeris' concept of problem orientation and student direction (Illeris 1974, 2015). Illeris, a former professor of Lifelong Learning, played a significant role in formulating the pedagogical foundation of a problem oriented learning approach in Denmark. This implies that the problem students are dealing with is formulated by the students, and is perceived to be essential to all participants in the group. In this educational setting we introduced another problem oriented learning concept, Kubus, developed by H. Herlau and H. Tetzschner aiming at training self-directed innovative teams. Kubus is based on the assumption, that groups will have certain knowledge as well as uncertainty and ignorance to deal with, and offers tools to handle these challenges in order to build an "artificial innovation climate" (Herlau and Tetzschner, 2006 a). The intention is to train students to manage innovation in groups in a very instable situation where neither the problem nor the needed information or knowledge is present.

The article is based on the meeting between these different pedagogical approaches in order to discuss the outcome when students (and educators) within a problem oriented learning environment are expected to adapt to a new tool aimed at supporting students' problem finding process.

In the article we will present the general principles of the problem oriented learning approach and the principles of the Kubus approach. These approaches are then analysed by means of Activity Theory (Engeström 1997, 2009) to highlight how they influence the way students are expected to deal with insecurity. We will then briefly account for our students' attitude when introduced to this tool and discuss the learning perspectives.

THE LEARNING CONTEXT – PROBLEM ORIENTED LEARNING

Learning occurs in a social and cultural context and this necessarily influences what and how people learn. Consequently, we must be sensitive to the learning context we offer students and how changes in the setting may influence students' learning.

There exist a number of forms of problem-based learning, and the concept in our context, problem oriented learning, is not to be confused with forms of problem solving learning (see e.g. de Graff & Kolmos (2003) for a typology). Problem-based learning (PBL) is based in an experimental learning tradition that has grown in breadth and depth across the world since the 1970. Maggi Savin–Baden (Savin-Baden, 2000) addresses PBL by its origin in McMaster University in Canada where Barrows designed a medical school curriculum based solely on small group, student-centred learning. The rationale for problem-based learning stemmed from years of observing experts engaged in clinical reasoning. Savin-Baden refers to four key reasons for the use of problem based learning (originally suggested by Barrows and Tamblyn 1980): to develop student's reasoning skills; to create a learning context which is relevant to the students, to ensure that learning is attuned to the world of work; to promote students' self-directed learning abilities, that is, learning that fosters independent enquiry (Ibid p. 15). The curricular content is based on problem scenarios rather than subjects or disciplines. Students work in groups to solve or manage problems, they are expected to engage with the complex situation, examine the gaps in their own knowledge and skills, and decide what information they need to learn, and what skills they need to gain to resolve or manage the situation effectively (Ibid). Savin-Baden stresses:

"Problem-based learning can help students *to learn with complexity*, to see that there are no straightforward answers to problem scenarios, but that learning and life takes place in contexts, contexts which affect the kinds of solutions that are available and possible"(Ibid p.5)

Health and medicine has a strong underlying disciplinary base, which is not the case in all disciplines, which means there is a more open space for both defining and solving problems. The learning context in the present case is a problem based learning environment at Aalborg University, and its tradition and origin is different from the approaches above primarily due to the role of the problem formulation. Students are required to formulate their own problem, and we regard this as an important difference. It is then important that students are open to different concepts and understandings, but also challenge those in order to progress.

A pedagogical challenge to problem oriented project work is to balance between accommodative and assimilative learning processes bearing in mind, that motivation through disturbance and conflicts of different kinds often is the starting point of significant learning processes: "There is a sense in which learning occurs whenever harmony between us and our world has been broken, so that the relationship between our present understanding and our experience of the 'now' needs to be established, or re-established. In other words, learning begins when we recognise that we are in a state of ignorance but a great deal of our everyday learning occurs at such times as the disjuncture is so slight that we barely notice it" (Jarvis, 2012, p.12)

Disjuncture may lead to fruitful wondering and questioning that enhances learning. This process may lead to transformative and accommodative learning processes activated when the individual meets situations, which challenge existing mental structures and patterns. This may led to changing of ideas or knowledge as this requires the learner to reshape concepts, referred to as *accommodative* and *transformative reconstruction*s. These processes can be more or less offensive or defensive, as impulses that are at odds with existing structures may be treated like *assimilation* of knowledge, which occurs when new ideas must "fit" into what is already known, and hereby prevent accommodation processes leading to defence mechanisms, as a response to the insecure situation.

Emotional interaction processes as responses to formative learning processes may then be regarded as a challenge to students' collaboration and knowledge sharing, as radical reconstruction of the individual's comprehension of certain sets of condition in a context may be a corresponding radical shift in emotional patterns (Illeris, 2007, p.83). Learning in project groups means dealing with own as well as other students' responses to the learning process. This opens for conflicts and may appeal to both emotions and to insight and understanding. (Illeris, 2007, p.93). In project groups students are dealing with a high degree of uncertainty. Consequently, the students' responses and dealing with this situation will influence the learning outcome of the project work, as transformative learning is linked to the creative dimension of a problem oriented learning approach, being open to challenges and dealing with insecurity.

Outline of the General PBL Structure

The PBL pedagogy practiced at Aalborg University is based on the research and theoretical work of, among others, Illeris (Illeris 1974, 1981), Hultengren (1976, 1979) and Negt (1975) and has over the years been further developed following research in the university's practices and due to influence from other PBL institutions (Krogh & Jensen 2013). However, the general structure still follows the outline described in Illeris' work, which we present below. Each semester (5 months) typically follows a structure consisting of 5 phases (Illeris, 2015):

1. *Introduction and group formation*, including clarification of practical rules and conditions, introduction and readings related to the subject area in question. This includes group formation (optimal size is 3-5 members) and choice of relevant, exemplary project theme.

2. *Problem formulation and practical planning*. This phase is considered very important, and the part of project work we take a particular interest in. Students' problem formulation should be experienced as relevant for the individual student in order to ensure involvement, and it is the phase where the group must reach an understanding of an experienced problem, and a subject for negotiation (Illeris, 1974).

"In this phase the specific problems of the project must be formulated precisely – a process that will also uncover a lot of biases and differences in the project group, forcing the group to make a series of fundamental decisions. Problem formulation is a very significant issue in the project method, and it is important that both students and supervisors pay the utmost attention to all details in the formulation so that the formulation can function as a common statement of what precisely the group has agreed on. It must be emphasized that this is fundamentally different from what has sometimes been called Problem Based Learning, because the problems are chosen and formulated by the students themselves and not by the curriculum, the teacher, or a textbook." (Illeris, 2015 p.48)

Practical planning of time, delegation of tasks, internal and external appointments is of great importance in this phase.

3. *The investigation phase* is the lengthy central phase during which the selected problem area is probed. This includes understanding the subject and to find relevant theory. A high degree of internal coordination and documentation of all agreements, decisions, references, ideas, drafts, etc. is important. Communication between the project group and the supervisor must, according to Illeris : " strike the difficult balance of providing professional guidance without forcing the group to accept his or her own interests or points of view."(Illeris, 2015, p. 48).

4. *The product phase* is usually about writing up the report and learning to outline, coordinate, and produce the report.

5. *External examination*, including assessment and individual grading. The examination is based on the report and not a randomly chosen topic from the curriculum, usually as a group examination with individual grading.

During a project period students are dealing with insecurity at different levels. Firstly, about who they are going to collaborate with and on what. This kind of insecurity is related to social skills: 'am I the kind of person anyone wants to have as a group member?' The selection process of group formation introduces some psychological insecurity as students know they are dependent on their group members and know that all are expected to become member of a group. This means that reputation is important. When settled in a group students are facing another kind or insecurity related to academic knowledge building, namely formulating an appropriate and relevant research question (problem formulation), which it is feasible to investigate within the time frame given.

The Problem Formulation in a Learning Perspective

Illeris states that transformative learning may take place at any time during the course of the project:

"But experience shows that the possibility of transformative learning is concentrated in connection *with problem formulation* (our emphasis), internal evaluation during the investigation phase, and the final internal evaluation and post-evaluation. This, of course, has to do with the fact that these phases include important considerations and decisions, as well as the possibility of internal disagreement, compromises, and other elements in which the individual's role in and contribution to the project are challenged." (Illeris, 2015, p. 49)

The learning potential of this phase, according to Illeris, is related to its embedded challenges. In order to learn students move from not-knowing (enough) to knowing (enough), and during this process they try out different methods and strategies in order to make sure that they know enough to formulate an (academic) relevant research question. The insecurity is linked to the fact that they primarily work with ill-defined problems. This means that the problems have no clear initial state, so the nature of the solution is not predictable or convergent. Insecurity is here related to their subject oriented lack of knowledge i.e. they do not know a priori how to understand, describe and problematize the phenomenon. This kind of insecurity should not be confused with feelings of personal insecurity in a psychological sense, but is related to the emotional aspect of learning and acts as a driving force of the learning processes. Defining the problem might require knowledge of different subject areas and theories, which mean that students are dealing with a high degree of complexity which should gradually be reduced by means of the problem formulation as well as feedback from their supervisor. Students are creating knowledge through working with the problem during all phases and the research problem may take different forms though the learning process.

The problem formulation is supposed to guide and focus their research of the problem, but must also be sufficiently dynamic as it part of a circular process: more knowledge may entail adjustments in the problem formulation. During this process students are expected to be involved in the knowledge creation process of group members, and they may be constantly questioning the relevance and the quality of their common product, so insecurity shows in questioning their current knowledge. This questioning is expected to secure the quality of the product, but it also means questioning the quality of other group members' contribution, which might be an emotional challenge. As each project is new in the sense no one has created a similar project before, no one can guarantee that the learning process will succeed in a project, which can pass examination. Furthermore, students may choose to explore a problem, which is new to their supervisors. In this sense they create a real situation of insecurity, as the outcome may be unpredictable (Lund, 2015; Lund & Jensen, 2013). Dealing with insecurity is consequently an important part of the process.

Adding to the insecurity is the fact that students sometimes have conflicting interests in the group when choosing and finding the problem to investigate. They have to make a choice without having the needed information. From a learning perspective this open phase is regarded as being both frustrating and necessary if students are to develop innovative and creative skills. Being able to deal with insecurity is part of an explorative and creative learning process (Darsø, 2001; Kupferberg, 1996; Kupferberg, 2006). Other challenges of the problem formulation are that students experience it as time consuming and resource demanding, and as a consequence may be tempted to end the process too quickly.

We therefore took an interest in ”tools” attempting to support and manage students' time and collaboration. In the Master's program in question the students' subject was learning and change processes within a course dealing with pedagogical innovation. Consequently, we were looking for tools, which would familiarise our students with different ways to foster innovative capability. We therefore introduced a tool named Kubus, in order to deal with both aspects at the same time.

PRESENTATION OF KUBUS – THE INTRODUCTION OF A 'PRE-JECT' PHASE

The Kubus model has been applied and tested in various settings as a method for training entrepreneurship and designed to frame and support the work of self-directed groups.

The inventors of Kubus regard knowledge production as a practically oriented interactive process. The Kubus model was developed for a business school setting and is based on empirical case studies of how interdisciplinary groups (primarily student groups) work in projects (Herlau & Tetzschner, 2006). Kubus supports, directs and visualizes the working process and knowledge building and sharing within a group in interaction with networks and partners outside the group. Kubus has special concerns for the *problem finding phase* - a dynamic phase of problem identification, problem framing and re-framing. The assumption is that ill-defined problems demand more complex knowledge to frame and to solve. *Problem finding* in complex situations is hence dependent on knowledge sharing and *problem framing.* In self-directed group work students' learning object is to negotiate, discuss and challenge the others' framing of the problems. Herlau and Tetzschner refer to this problem finding phase as a *pre-ject phase.*

The general idea of the *preject* phase is to gather as much information and gain as much knowledge as possible on a subject, a question, a problem, an idea *before* deciding on the action to take, whether it should be to discard that line of work or whether it should be to pursue it further. During the preject phase students work in *a divergent mode*, i.e. by researching an increasingly broader area based on their point of departure; to identify and analyse potential sources of innovation; and to build a solid foundation of knowledge. The

preject phase is terminated when the group, who ideally is a cross disciplinary team, identifies such sources. After that they enter into the goal directed and goal fulfilling *pro-ject* phase, using known methods for project management. The Kubus method is defined as a management method designed for use during the pre-ject phase.

Throughout the problem finding process – the preject phase - the students are in contact with a company/others involved through a database called the Template . This allows the company to follow the process and to comment on it. Students must try to solve a problem defined by the student group itself through a careful investigation of the company's "surroundings" and inner resources. This is carried out in a structured way by means of a model for collaboration and information gathering.

A vital part of the concept is the database: KUBUS Template, which is specifically developed to manage entrepreneurship understood as innovation processes. Ideally students' object is to learn to cooperate, to network, to collect knowledge about problems, and to find viable solutions. Using the database involves collecting and structuring knowledge about who will be able to solve the problems – within as well as outside the group. During the process of analysis the students communicate with different parts (employees) of the company to access their tacit knowledge. The idea is that the students are trained to use their academic knowledge and transform it to a new and useful practice trough action learning in dealing with "real" problems.

A Kubus-group has a task related to external interaction involving development of network (finding key people, partners, and specialists, social and business contacts) and transform results to external data (from the market, competitors, customers, libraries, internet, databanks) and to share these with their peers. By following (embedded) rules for sorting the different data different sources of knowledge become visible to all members of the group. The template keeps track of all internal and external communication, and must continually be updated in order to visualise who is doing what, what has already been done, and who is communicating with who in order *to share and visualise the task and its progression*. Distribution of assignments and their completion thus becomes transparent. All data must be coded abiding certain rules according to the content of the conversation and divided into the 6 different areas (hence the name 'Kubus'): reflections of the team, external data, network, documented knowledge, project resources, and open questions. In this way all data can be quantified afterwards.

Kubus encompasses several formats of application, like meeting agenda as well as two different types of minutes from the meetings, which prescribe the meeting forms and agenda. The group has two kinds of leadership, which all group members are supposed to take: Red leader takes care of network, project resources, and knowledge distribution. Green leader keeps track of what needs to be investigated, access to external data and group climate. Green

leader is supposed to handle the situation related to "not knowing" by addressing open wh-questions and hereby gaining knowledge. Green leader then focuses on the internal knowledge, as Green leader is supposed to find the most rewarding suggestions for knowledge gathering in order to facilitate Red leader's strategic function. The group searches for the lacking knowledge and Red leader must ensure reasonable management of time and resources while following the group's strategy. The group itself is to be managed through the group's social codex and the internal management function. The Kubus Template hereby visualises the complex management of a group, when being in constant interaction with external partners (network and external data), contributing to data and knowledge as well as the resources of the group, meaning how many assignments are to be fulfilled compared to the actual resources in the group.

In this way the group is explicit about group culture and otherwise implicit rules for behaviour and creates rules to access the community. This codex combined with the clear distribution of leadership roles means that there is a basis for performing transparent leadership. As all the members of the group will, at some point, be Red and Green Leader they get to understand the role of the decision maker as well as the role of the person in charge of the group climate, and they ideally understand the necessity of being or becoming 'leadable', i.e. accepting the decisions of the group and the leader and contributing to the group's work. These rules are expected to be followed and to affect the students' division of labour, with consequences for the outcome. The Kubus tools hereby deliberately intend to build an activity system by creating new rules and objects, with consequences for the community – Kubus aims at influencing the students' interaction by division of labour and operation by being concerned with the pre-ject phase – and naming this process in order to separate it from the pro-ject phase.

To summarize:

The purpose of using the model is not primarily to create radical innovations but to create knowledge potential and knowledge depth, which may be the basis of future innovation. Communication and knowledge building appear as central concepts and there is a strong emphasis on transparency of group processes through documentation and articulation.

COMPARISON OF THE TWO PEDAGOGICAL APPROACHES

The main difference between the two problem oriented learning approaches is how they consider the importance of problem formulation as well as the role of the supervisor. In the problem oriented pedagogy the supervisor plays an important role, whereas the Kubus model intends to create autonomous groups.

Both the problem oriented learning concept and the Kubus concept are concerned with the knowledge creation process. Both recognise the managerial aspects of group work and the process of "not-knowing", but the managerial aspects are "hidden" or tacit knowledge in PBL. Both concepts recognise knowledge transformation as challenging, especially, in the early stage when the group is left with very vague ideas about the problem they want to address. The problem-oriented pedagogy describes the ideal elements of this process, but does not support it with specific tools and thus leaves this (relatively) frustrating process for the students to handle. Though it might be regarded as educational from the perspective of transformative learning, the general view is that group conflicts should be avoided, and it is a general view among our students, that they find group conflicts and disagreements unpleasant, time and energy consuming.

Kubus aims at avoiding this problem by an enforced focus on management and creation of a structure which makes the students independent of guidance and makes all processes transparent when it comes to group management, the students' handling of knowledge, the idea development and students' work and work ethics. Kubus hereby creates a structure to minimise conflicts and create a foundation for efficient teamwork preparing the students to enter the project phase – a goal directed and solution oriented process.

Kubus intends to create and frame students' ability to recognise the phase of insecurity by naming the process – the pre-ject phase – and claims that it needs special management, since the process is characterized by being non-linear, divergent and process driven. The assumption is that it is very challenging to collaborate without a defined problem to solve. Consequently students tend to avoid this situation by rushing into the problem solving phase too early and define the problem without being fully aware of the "the missing knowledge". Kubus draws attention to the dynamics and reiterative process of generating ideas as part of problem finding.

DIFFERENT ACTIVITY SYSTEMS

We analyze the Kubus tools with inspiration from an activity theory perspective, which claims that teaching and learning are activities that are socially situated and influenced by the culture and the community of its context. From this perspective, tools - including mental models - mediate the learners' actions. Our intention is to analyze and compare in which ways the students' use of Kubus mediates their learning activities and whether it influences/reduces uncertainty.

Activity theory is founded in the cultural-historical school/tradition. It builds on the basic assumption that human action is a combination of intellectual and manual activity. Relations between human beings and between the individual human being and its surrounding world is

established and further developed through the activities in which the individual takes part. The practical and productive interaction with the surroundings is thus decisive also for the psychological processes. A basic assumption is therefore that learning and development becomes a question of exploiting / making use of the cognitive resources which are embedded in artifacts such as information, procedures and routines. Consequently, in a learning perspective it is important to analyze which mediating effect or influence language and technology have on the learning activity. In this analytical frame dialectics and dynamics are important features. Cognition is not only impacted by "context" but it is also co-constructive of "context" (Otero, 2003). Within this framework we expect the "tool" to influence the students' action.

In an activity theoretical perspective the relation between Subject, Object and Tool/Instrument is considered of crucial importance to learning (development of intellectual and physical competences). The relation between Subject and Object is not immediate and individual – it contains a collective dimension as knowledge, insight, conventions and concepts have been integrated into the Tools, and are something we interact with - and through - when we act. Consequently, persons gain experience based on the mediating tools. The mediation influences our thinking and imagination and is both a product of and influenced by our culture and its intellectual and physical tools.

Center for Activity Theory and Developmental Work Research at Helsinki University in particular has developed models for the analysis of the numerous relations which structure and create sense-making in human activity. We are inspired by Yrjö Engeströms Activity-Theoretical Approach to Developmental research and apply some of his models.

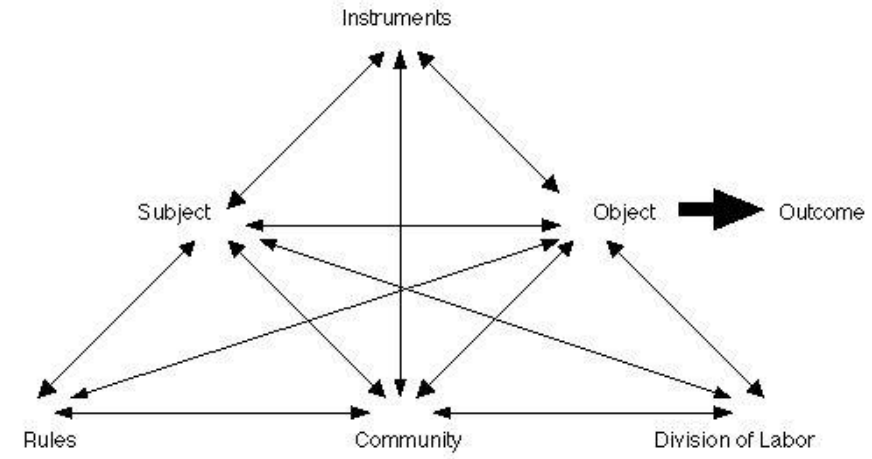

Fig. 1

The basic model consists of Vygotskij's triangle, where the subject-object relation forms the bottom and "tools" are at the top of the triangle and mediate the relation between subject and

object. Leontjev introduced division of labour to his model in order to distinguish between goal oriented actions on the one hand and object-oriented collective systems on the other hand: "*A collective activity can only be carried out by dividing the labour among the members of a community, that is, by assigning different actions to different participants. This requires rules that regulate and sanction exchange and interaction among the participants. The cultural meaning and personal sense of an individual action can only be deciphered by seeing it in the context of the activity it realizes."*(Engeström 2009: 23)

On this foundation Engeström builds his dynamic mediational system. The object creates the dynamic activity in the system, and Engeström (2009) emphazises that activities are open systems that depend on each other, forming various partnerships and networks around partially shared objects. Human activity makes its own context, which is in constant movement, historically and interactionally. Engeström argues it is analytically useful to identify the general anatomy, or inner structures, of a collective activity system, as well as some dynamic of its movement (Engeström, 2009) to analyze the dialectic between object and mediating artifacts in order to understand how tools mediate and change an activity system. Consequently we use this framework to understand what characterize Kubus as well as the conceptual construction of project work, in order to discuss which kinds of activity system they create and to understand how Kubus may change established rules and objectives regarding project work.

The Kubus-group as an Activity System

In the Kubus-group understood as an activity-system the Subject are the students and in this particular case the Object was students' learning to use the tools of the Kubus-model, as they are seen as artifacts containing/embodying knowledge of the processes of innovation and entrepreneurship. The activity of the group is mediated through the tools and techniques of the Kubus-concept, laying down specific Rules regarding group management, collaboration, information-/knowledge-gathering and knowledge-creation. As the Kubus-tools and techniques consist of a number of operations (concrete actions at a micro-level) they deliver clear instructions regarding the Division of Labour within the group, and install group-autonomy through firmly regulated management, work routines and meeting procedures, some built into the Kubus Template. The group makes its own imprint on the Rules by negotiating and drawing up a Social Codex detailing the expected and acceptable norms of behavior of the group.

The Outcome of the activity may be manifold: The Subject, i.e. the students, changes due to the learning activity. They acquire group management competences through the routinization and automatization of the large number of detailed operations inherent in the tools and techniques (e.g. Red/Green leadership, time-management, decision-making, transparency); they acquire skills in gathering, managing and creating knowledge in the insecure pre-ject

phase and hereby acquire skills in being entrepreneurial, which implies risk management. All agreements and actions are recorded, and failure to fulfill agreements becomes visible, and rules for which action to take in such cases are provided by the Kubus-model. Finally the Outcome may be a solution to a real problem in a given context.

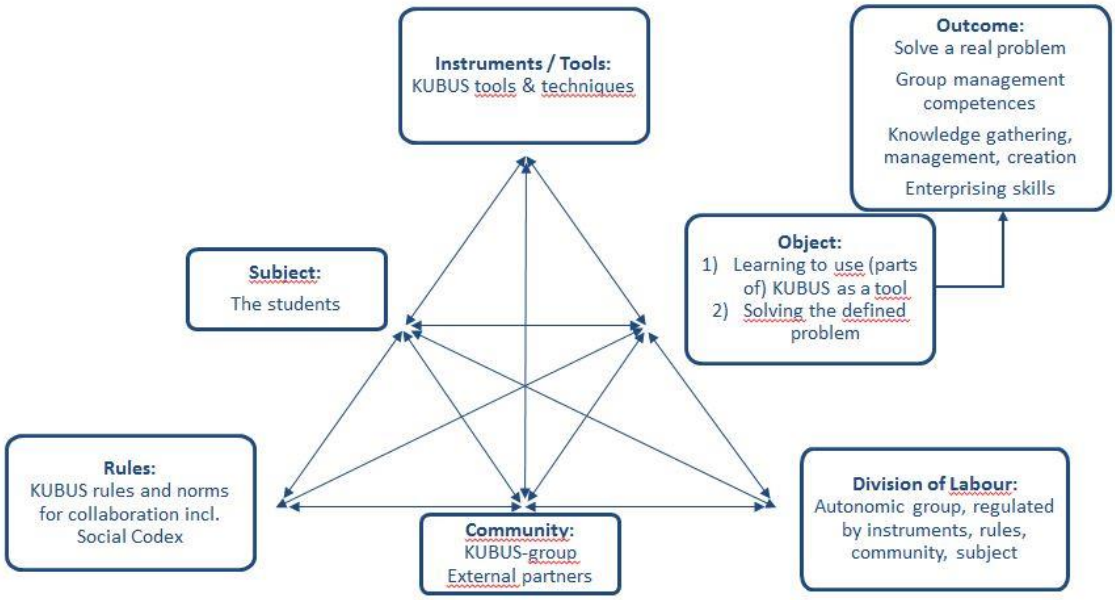

Fig. 2

Kubus reflects a specific understanding of innovation and entrepreneurship in which efficiency is important in order to speed up innovation processes by facilitating the preject phase. Students are taught to deal with insecurity by structuring and formalising collaboration in order to visualise what is already done and what needs to be done.

Problem Oriented Project Work in Groups

The dominating activity system at Aalborg University is Problem Oriented Project Work (which is often referred to as the Aalborg Problem Based Learning model) and this is what the students are familiar with.

Like in a Kubus–group the Subject of the activity is the students, but the Object of the activity is the learning involved in the group's project work, i.e. to gain in-depth knowledge about a specific area selected by the group within the specific knowledge domain determined by the curriculum. The Instruments or Tools for the learning activity are the problem-oriented project-work understood as a particular pedagogical model for learning, which on the one hand is the basis for the Rules regulating the activity, and on the other hand influences and is influenced by the activity and interpretations of the Community. The Community consisting

of the study groups and the supervisors interprets the Rules of the activity, and represents and embodies the local traditions of how to understand, explicate and carry out problem-oriented project work with the roles and tacit knowledge. In this respect the Community will influence the Division of Labour within the project group. The actual Division of Labour within the project-group, however, will be created by the group-members through interaction and negotiation with focus on the object. The group will – in concert with their supervisor – discuss and determine the courses of action regarding the Object of the activity.

The activity regarded as a learning activity should ideally result in two types of outcome: the change of the Subject (the students) as a consequence of the learning processes of being involved in knowledge-gathering, knowledge-management, and knowledge-creation, i.e. 'operations'. Through such concrete actions they will have gained routines in carrying out these procedures. Changes of the Subject will in turn influence the entire activity system. The second type of outcome consists of the products produced (the project report), and a grade expressing the wider activity system's assessment of the activity in relation with the dominating norm: to assess the outcome. Due to this activity system the students define the problem to investigate and their methods through conversation with their supervisor, which implies discussing and negotiating about object, method and division of labour.

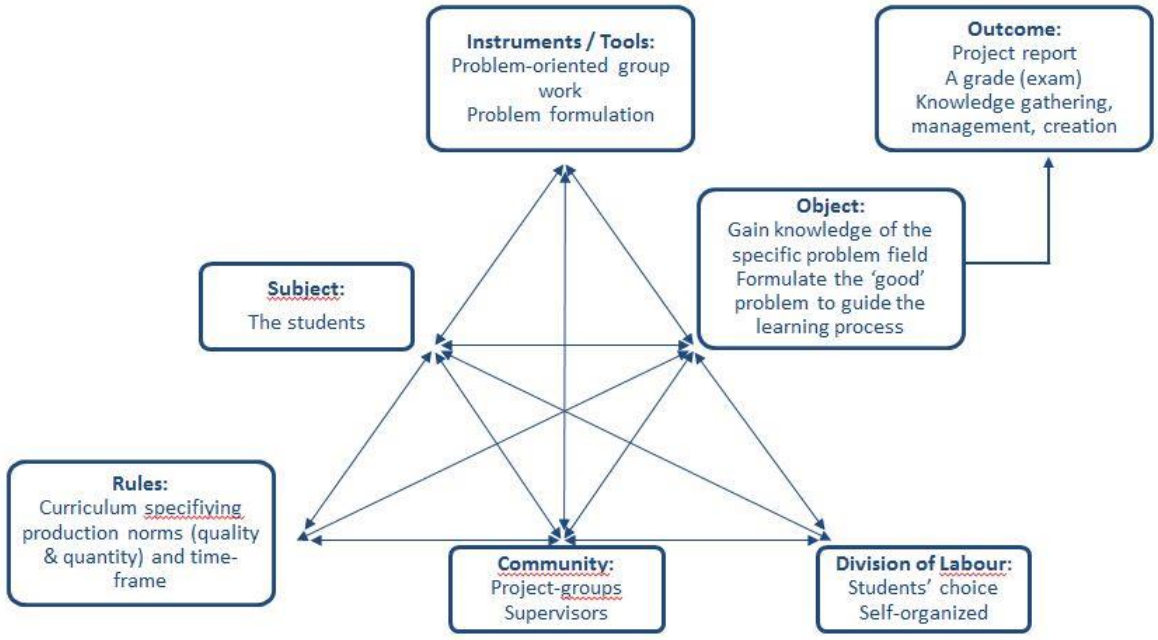

Fig. 3

As described, many options are open in this phase and it may be experienced as a period of uncertainty where only the supervisors may offer some facilitation.

FINDINGS AND PERSPECTIVES FROM THE IMPLEMENTATION OF KUBUS

We introduced three cohorts of students at the Master's programme in "Learning and Innovative Change" to Kubus to support the initial phase of their project work. Students in this programme study innovation and were at the same time objects of pedagogical innovation through this experiment. Kubus in a light version was introduced in the "preject phase" of the project, i.e. the problem formulation phase, but we underestimated the significance of the problem formulation aspect, and the fact that this aspect is not part of Kubus. It was introduced by means of literature studies and presentations of the concept and with the (naïve) expectation that the students would welcome this intervention and renewal of the problem oriented learning concept. But we learned that our students responded differently to changes in their learning environment.

Some groups devoted their time and effort to learning to use the Kubus tools and techniques, and they were generally positive regarding the usefulness of the method referring to the challenging emotional aspects of the learning process in project work:

> *"I have some times felt that it has been a little difficult out here, what with groups and so on, also because it is very touchy-feely. You can't really say what you mean, because you can't hurt the others' feelings, and in this respect I think that this tool is such a really great tool, because it just lifts that out. There are some people who are a little more afraid of saying something and so on, and are very ill at ease and so on, and this is a very cool tool, because it puts people's minds/brains in play, and what they are capable of, because you don't have use so much energy on thinking about the others and that social stuff. I just think that it has been so great. I also believe that that is the reason why it goes so well. It simply functions so well because it is feeding off our ideas and our creativity."*

In this case the feelings of insecurity seems to have been reduced due to the Kubus tools with a positive outcome regarding idea generation.

However, Kubus was in general experienced as a complex and time-consuming concept to understand and to apply. Few groups tried sufficiently to acquire the tools, because they considered it too complicated and it was disturbing their primary object, i.e. to find and solve a self-defined problem, which they focused on. Having to deal with the complexity of the new tools introduced an extra dimension of insecurity into the process by breaking students' habits which was not welcomed in all groups, as this demanded the students to reflect on managerial aspects and the roles of the "born" leaders in project groups. Also, the students may have experienced the supervisors' changed role as adding to the insecurity.

However, some students who were generally critical towards the Kubus-experiment at the same time regarded elements of Kubus as beneficial for their PBL work. They therefore decided to be both critical and constructive and change the forthcoming course. These students were offered additional instruction in Kubus to allow them to develop a course for the next cohort to fit into their context by integrating the aspects of Kubus they found beneficial to support their group-work – i.e. the managerial tool for division of labour but without the transparency element of visualizing work-sharing and individual contributions to the project work. The students thus adjusted and integrated elements from the Kubus into the PBL model, which could scaffold the problem formulation phase and thus help dealing with the insecurity of that phase. Simultaneously, they were making sure that this part of the Kubus activity system would not be in conflict with the PBL activity system and its pedagogical values. In this way they added to the potential learning outcome of the processes.

DISCUSSION

There are distinct differences in the two pedagogical approaches: Kubus is constructed to create an efficient and regulated framework around self-organized groups to speed up knowledge management and future innovations. The intention of the problem oriented learning approach is to stimulate and motivate learning processes and create scientifically competent students, that are able to research and question established knowledge, and who might be innovative as well.

Kubus delivers a set of rules and guidelines to abide by – whereas PBL leaves much up to the group itself to decide. Due to the strong framework surrounding the Kubus-group it is expected to be self-directed and self-sufficient with very little external support in the process. There are no evaluation criteria of the value of the findings and solutions. Quality assurance is embedded in the structure and carried out by following the rules. In contrast, the PBL-group is expected to work independently on negotiating its own framework for collaboration, but with the support of a supervisor. The role of the supervisor is, amongst other things, to ensure the academic level and subject oriented relevance of the learning processes. There may be elements of apprenticeship, which both introduces students to, and maintains, academic habits and culture. Furthermore, the supervisor should support the group in creating an atmosphere where group members may express doubt and uncertainty (Illeris, 2015 p. 49). The supervisor is therefore an important factor for the learning process, not least during the problem formulation phase, as she/he is confronted with all aspects of students' learning process.

The framework offered by Kubus may to a large extent reduce the insecurity of the initial phase, which the groups have to learn to cope with in the PBL-approach. However, from a learning perspective it could be argued that while the reduction of insecurity is desirable, cf. the above quote, learning to deal with insecurity might on the other hand open to important

learning potentials in the form of transformative learning. In Illeris' understanding transformative learning means a change of the learner's identity through personal development, deeper understanding, tolerance and flexibility (Illeris, 2015 p. 50) and is closely related to processes including discussion, disagreement, compromising and decision making (p. 49) and thus not something to avoid. The ideal learning scenario would consequently balance between 'sufficiently' safe environments to promote creativity and 'sufficient' insecurity to promote transformative learning.

The introduction of Kubus in this context illustrates that the value of a tool is related to established habits and traditions, supported by and framed by the activity system. This shows that new knowledge is shaped by the learner's existing knowledge and experience (Dewey, 1910), and consequently frames what students regard as important. Introduction of Kubus meant that the students had to accept a specific, but implicit, understanding of innovation in a pre-ject phase (dealing with not-knowing) and knowledge management (by shared leadership) in order to use it properly. The students accepted to some extent the managerial benefits of Kubus. This shows how knowledge-use is a part of a knowledge re-conceptualization process, and explains why what works in a particular field is not easily translatable to actual practice if transferred from another context, since the knowledge transformation process is complex. New knowledge is formed by prior understanding, and Kubus may not correspond with the students' conception of project work, so they either dismiss it or transform it.

To expect changes in behavior, leading to more efficient educational processes on the basis of implementing Kubus may then sound a bit naïve, but new concepts can offer insight and ideas and new understandings of established practices. The introduction of Kubus might add value by verbalizing the tacit and given managerial process around problem formulation and hereby pointing at the importance of more efficient group structures and collaboration. The introduction of Kubus shows that educators must be aware of how new pedagogical practices are interpreted in the context of the established culture (the community), and welcome the disturbance it might introduce, as it may visualize implicit values in the existing culture.

References

Darsø, L. (2001). *Innovation in the Making*. Frederiksberg: Samfundslitteratur

Dewey, John (1910). *How we think.* Amherst (1991)

de Graff, E. & Kolmos, A. (2003). Characteristics of Problem-Based Learning. *International Journal of Engineering Education.* Vol. 19, No. 5, pp. 657-662

Engeström, Y. (1997). Coordination, cooperation and communication in the courts. In *Mind, Culture, and Activity*, Cpt. 28, pp. 369–388. Cambridge University Press

Engeström, Y. & Sannino A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review* 2010, doi:10.1016/j.edurev.2009.12.002

Engeström, Y. (2009). From learning environments and implementation to activity systems and expansive learning. *Actio: An International Journal of Human Activity Theory*, No. 2, 2009, pp. 17-33. The Center for Human Activity Theory, Kansai University

Herlau, H. & Tetzschner, H. (2006a). *The Kubus® Concept: 'Preject' Management and Innovation*. Copenhagen and Esbjerg 2006. http://www.itu.dk/people/cmmm/(HT&HH2)%20kubus_preject.pdf

Herlau H. & Tetzschner, H. (2006). *Kubuskonceptet – prejektledelse og innovation*. Frederiksberg: Samfundslitteratur.

Hultengren, E. W. (1976). *Problemorientering, projektarbejde og rapportskrivning.* Institut for Uddannelse og Socialisering. Aalborg Universitetscenter.

Hultengren, E. W. (1979). *Tværfaglig undervisning som politisk undervisning.* Serie om uddannelsesforskning: 2. Aalborg: Aalborg Universitetsforlag.

Illeris, K. (1974). *Problemorientering og deltagerstyring – oplæg til en alternativ didaktik.* København: Munksgaard.

Illeris, K. (1981). *Modkvalificeringens pædagogik – problemorientering, deltagerstyring og eksemplarisk læring.* København: Unge Pædagoger.

Illeris, K. (2015). Transformative Learning in Higher Education. *Journal of Transformative Learning*, Vol. 3, No. 1, 2015

Jarvis, P. (2012) Learning from Everyday Life. *Human & Social Studies. Research and Practice.* vol. I, no. 1

Krogh, L. & Jensen, A.A. (2013). The Development of PBL-Methodologies in Denmark and Current Challenges. In L. Krogh & A. Aarup Jensen (Eds) (2013), *Visions, Challenges and Strategies. PBL Principles and Methodologies in a Danish and Global Perspective.* Aalborg: Aalborg University Press.

Kupferberg, F. (1996). *Kreativt kaos i projektarbejdet*. Aalborg : Aalborg Universitetsforlag.

Kupferberg, F. (2006). *Det kreative underskud*. Dansk Center for Undervisningsmiljø. http://dcum.dk/undervisningsmiljoe/det-kreative-underskud

Lund, B. & Jensen, A.A. (2010). Framing of collaboration and its impact on creativity and innovative skills. In M. Horsbøl (2010). *Communication, Collaboration and Creativity. Researching Adult Learning.* Odense: University Press of Southern Denmark.

Lund, B. (2015). The notion of emotion in educational settings when learning to become innovative and creative. In B. Lund & T. Chemi (Eds) (2015), *Dealing with Emotions: A Pedagogical Challenge to Innovative Learning*. Creative Education Bookseries Vol. 3, pp. 1-20. Rotterdam: Sense Publishers.

Lund, B. (2017). Managing student's emotion in order to foster innovation – a critical view on entrepreneurship education in schools. In T. Chemi, S. Grams Davy & B. Lund (Eds) *Innovative pedagogy - a recognition of emotions, passion and creativity in education.*. Creative Education Bookseries. Vol 4. Rotterdam: Sense Publishers.

Lund, B & Jensen, A. A. (2013) Creativity Development by management training in POPBL. In L. Krogh & A. Aarup Jensen (Eds), *Visions, Challenges and Strategies: PBL Principles and Methodologies in a Danish and Global Perspective*. 1. ed., pp. 117-138. Aalborg: Aalborg University Press 2013

Negt, O. (1975). *Sociologisk fantasi og eksemplarisk indlæring.* Roskilde: Roskilde Universitetsforlag.

Otero, V. K. (2003). *Conceptual Development and Context: How Do They Relate?* School of Education, University of Colorado, 249 UCB, Boulder, CO 80309 (Localized on the web August 2010)

Savin-Baden, M. (2000): *Problem-Based Learning In Higher Education: Untold Stories*. Buckingham: The Society for Higher Education & Open University Press

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 71-80
http://dx.doi.org/10.5278/ojs.jpblhe.v0i0.1243

The Implementation and Evaluation of a Project-Oriented Problem-Based Learning Module in a First Year Engineering Programme

*Seamus C. McLoone, Bob J. Lawlor, and Andrew R. Meehan **

ABSTRACT

This paper describes how a circuits-based project-oriented problem-based learning educational model was integrated into the first year of a Bachelor of Engineering in Electronic Engineering programme at Maynooth University, Ireland. While many variations of problem based learning exist, the presented model is closely aligned with the model used in Aalborg University, Denmark. Key learning outcomes, implementation features and an evaluation of the integrated project-oriented problem-based learning module over a two year period are all presented within.

Keywords: Collaborative enquiry-based learning, peer learning, problem based learning

INTRODUCTION

Since its foundation in 1974, the Aalborg University has developed a world-wide reputation as a centre of excellence in problem and project based learning, particularly in the disciplines of Engineering and Science (Kjersdam & Enemark, 1994). This educational model is widely known as the Aalborg PBL model and is founded on problem-based project work. Here, the project is an integral part of the education model and hence the project-oriented problem-

* Seamus McLoone, Dept. of Electronic Engineering, Maynooth University, Maynooth, Co. Kildare, Ireland. Email: seamus.mcloone@eeng.nuim.ie
Bob Lawlor, Dept. of Electronic Engineering, Maynooth University, Maynooth, Co. Kildare, Ireland. Email: bob.lawlor@eeng.nuim.ie
Andrew Meehan, Dept. of Electronic Engineering, Maynooth University, Maynooth, Co. Kildare, Ireland. Email: ameehan@eeng.nuim.ie

based learning terminology. The literature shows that PBL, as an educational model, has many important pedagogical benefits, including improving active learning, encouraging a deeper approach to learning, improving self-directed learning, improving the consideration of interdisciplinary knowledge, developing a professional identity and developing responsibility. In addition, students also improve various process competencies such as project management, collaboration, teamwork, conflict resolution, and communication skills (Biggs, 2003; De Graaff & Kolmos, 2003; Hmelo & Evensen, 2000; Kolmos, 1996; Savin-Baden, 2003).

This paper presents the implementation and integration of a PBL model, in the form of a circuits-based project, into the first year of the Electronic Engineering degree programme at Maynooth University, Ireland. It was endeavored to align the model with the Aalborg PBL model insofar as resources and infrastructure allowed. At the end of the semester, the students were surveyed for their feedback on this new style of learning for them. Feedback for two different years was obtained. Both staff and students were also given the opportunity to express their thoughts and opinions through special focus groups. The results from this evaluation process showed significant support for the PBL educational model.

The rest of the paper is structured as follows. Section 2 outlines the context for and the aims of the new PBL circuits-based project module. Section 3 shows how this module was integrated into the first year of the Electronic Engineering programme at Maynooth University. Implementation issues such as facilitation, team selection, and assessment deliverables are presented in Section 4. Section 5 documents the evaluation process for the PBL module and presents a summary of the key feedback obtained. The paper concludes with suggestions for future work in section 6.

CONTEXT AND AIMS

The Department of Electronic Engineering at Maynooth University offers a standard four year Bachelor of Engineering in Electronic Engineering programme. Each academic year consists of two 15 week semesters, 12 of which are used for the delivery of relevant material and the other 3 consist of study and examination periods. Each semester contains 30 ECTS (European Credit Transfer System) of work, typically consisting of six 5 ECTS modules. These modules consist of standard lectures, tutorials, laboratory and/or assignment work and are usually delivered in the traditional style of the lecturer presenting material to the students through lectures.

The issue with the pre-PBL programme was that students were not exposed to any significant team-based project work. The programme did contain teamwork elements, but these generally consisted of 2 or 3 person teams working to complete short laboratory work within a module. Students only carried out their first substantial project in their final year of the programme where they are required to undertake an individual 20 ECTS project over the course of the full

academic year. Furthermore, while students undertook a professional skills module in first year that covered communication skills, they never had a genuine opportunity to put these skills into practice until their final year project, at which point they had little or no opportunity to receive useful feedback.

The Department felt that the introduction of a PBL model early in the programme would alleviate many of the aforemetioned issues. As such it was decided to include a 10 ECTS PBL module in year 1 with the aim of achieving a number of key learning outcomes. These included students being able to apply project-based learning to solve unforeseen problems, discuss any ethical issues, environmental impacts and health and safety issues associated with the project, write a technical report, prepare and deliver an oral presentation, defend their work via an interview and demonstrate good time management and project planning in the execution of their project.

INTEGRATION OF THE PBL MODEL

The conventional (pre-PBL) first year of the Electronic Engineering programme is presented in Table 1. In order to integrate a circuits-based PBL module, EE105 Professional Skills and EE107 Engineering Design were replaced with a 10 ECTS circuits project, as presented in Table 2. The EE109 Electronic Material Science module had to be moved to the first semester to accommodate this change.

Year 1 – Semester 1
EE101 Electronic Engineering Fundamentals
CS141 Introduction to Programming
EE103 Digital Systems 1
EE104 Physics for Engineers 1
EE105 Professional Skills
EE106 Engineering Mathematics 1
Year 1 – Semester 2
EE107 Engineering Design
EE108 Computing for Engineers
EE109 Electronic Materials Science
EE110 Physics for Engineers 2
EE111 Electric Circuits
EE112 Engineering Mathematics 2

Table 1 – First year programme pre-PBL (all modules are 5 ECTS)

The project forms a significant component of semester 2 and is directly supported by the taught modules EE101 Electronic Engineering Fundamentals, EE103 Digital Systems 1 and EE111 Electric Circuits, as highlighted in italics in Table 2. It is also indirectly supported by both the mathematics modules and the physics modules, as these provide the fundamental principles used in the engineering related modules.

Year 1 – Semester 1
EE101 Electronic Engineering Fundamentals
CS141 Introduction to Programming
EE103 Digital Systems 1
EE104 Physics for Engineers 1
EE106 Engineering Mathematics 1
EE109 Electronic Materials Science
Year 1 – Semester 2
EE108 Computing for Engineers
EE110 Physics for Engineers 2
EE111 Electric Circuits
EE112 Engineering Mathematics 2
EE199 Electronic Circuits Project (10 ECTS)

Table 2 – First year programme post-PBL (all modules are 5 ECTS unless otherwise stated)

Conducting a significant group project provides students with the opportunity to experientially develop their design, technical writing, presentation, and teamwork skills. This covers the key elements of the removed modules EE105 and EE107. In addition, the lecturers of EE105 and EE107 acted as facilitators for the new PBL module. Hence the overall structure of the first year programme and the staffing resource issue remained largely unchanged. This allowed for a relatively seamless introduction and integration of the particular PBL module within the BE programme.

In Aalborg University, the supporting taught modules are in the same semester as the project and are primarily delivered in the first few weeks of the semester. The project is run in parallel but the majority of this work usually takes place in the later weeks of the semester once the taught modules have been completed. Unfortunately, our current infrastructure does not support this upfront demand on teaching as several of the modules are taught by other departments within the university. By way of compromise, and in order to minimise

disruption to the existing setup, the project was deliberately placed in the second semester so that modules EE101 and EE103 could be delivered as they are, and in full, in the first semester.

IMPLEMENTATION

The PBL module was first introduced in semester 2 2013 and presented once again in 2014 to a new cohort of first year students. Key implementation details are now presented and justified.

Workshops - In Denmark, and indeed much of mainland Europe, students enter university at the average age of 19 years. In Ireland, this figure is 18, with some entering as young as 17. Thus, Irish students tend to be generally less mature than their European counterparts. In addition, incoming Irish university students have very little prior experience of group project work whereas the Danish primary and secondary education systems involve group-work components. As such, it was important to ease the transition of the students from the conventional taught lectures to the student-directed self-learning that PBL entails. As part of this transition, a series of 5 workshops were included within the PBL module. The topics covered included the concept of PBL, teamwork, design fundamentals, ethics, technical report writing, and presentation and interview skills.

Team Formation - Two different team selection processes were employed. In 2013, students were allowed to self select their teams, as per the Aalborg PBL model. The class initially consisted of 18 students and it was agreed at the start to have a maximum of 3 groups. The self selection process resulted in 3 quite different groups and contained 7, 6 and 5 team members respectively. Each of the groups was randomly given a project specification. In Aalborg University, students choose their own project in agreement with a supervisor.

This selection technique resulted in the creation of a ‘leftover’ group. As the term suggests, this group consisted of those students that were not in attendance on the day the teams were selected and also the perceived weaker students in the class. This group had significant problems throughout the semester including poor communication, poor teamwork, multiple conflicts with no real resolution and, ultimately, poor project work. It was no surprise that this group failed their project as a result. The key problem with this group was the fact that several of the students simply did not engage and/or did not even turn up for meetings on a regular basis.

In 2014, groups were formed based on the students’ ranking of various project specifications. In this case, the class consisted of 26 students and it was decided to have 4 groups of no more than 7 members. The final selection resulted in two groups of 7 and two groups of 6 and all

students were given either their first or second ranked project. The problem of the leftover group did not materialize in this case.

Similar to the first year in the Aalborg model, slightly larger group sizes (i.e. greater than 5) were employed in order to provide the students with the potential challenges in relation to project planning, time management, communication and conflict resolution that a large group typically entails.

Deliverables and Assessment - Each group of students had to submit an interim report and presentation (worth 20%), a final (technical) report and presentation and interview (worth 70%), and a process report, consisting of a set of reflective journals (worth 10%). The reflective journals had to be submitted approximately every two weeks during the semester and had to consist of both team and individual reflections.

The interim report and presentation was due mid way during the semester and documented the group's progress up to that point. The final report and presentation was due at the end of the semester and documented the overall project work. The actual assessment also included individual interviews to determine each student's level of knowledge and understanding of the work carried out. Akin to the Aalborg model, the group was interviewed together in the same room, with each individual member getting asked their own questions. Questions covered all aspects of the work, as presented in the group report. At the end of the interview, the assessors discussed and agreed a suitable grade that best reflects each student's interview performance.

The use of the interim assessment allows students to experience the assessment process firsthand and better prepares them for the final report and interview at the end of the semester. In the Aalborg model, the final grade depends solely on what happens on the day of the end-of-semester group presentation and interview, while the Maynooth model grade also allows for partial credit to be gained during the semester.

Facilitation - The role of the staff in PBL is to act as facilitators to each of the groups. They encourage and support the students in their pursuit to acquire new information and to carry out their project work. They do not get directly involved with the project itself. The groups are responsible for all aspects of the project, including organizing meetings with the facilitator, booking suitable meeting rooms, writing agendas, etc. In cases where this does not happen, the facilitator should not, in general, intervene or try to arrange a meeting for the team.

However, as this was the first time the students were exposed to the concept of PBL, it was decided that for the first 5 weeks the facilitators would have a little more direct involvement in the process. Thus, teams were required to meet with their assigned facilitator at least once a week, regardless of what progress they had achieved. At the end of week 5 the facilitators

then adopted a more *laissez-faire* approach to facilitation and encouraged the students to take more control of the direction and management of their own project.

Timeline of Events - Table 3 shows a weekly breakdown of the various events relevant to the PBL module. Students were given this information at the start of the semester so that they had an overall picture of key milestones. It should also be noted that teams were selected and project specifications were handed out in the very first week of semester so that students had the maximum amount of time to work on their given project. The deliverables were spaced as evenly as possible over the course of the semester and the actual final interviews and presentations were held after the standard end-of-semester exam period, to allow the students adequate time for preparation.

Week #	*Events* / Actions Required
1	*Workshop 1, Team Formation*
2	*Workshop 2*
3	*Workshop 3*
4	*Workshop 4,* Reflective Journal Due
5	*Workshop 5,* Interim Report Due
6	**Interim Report – Presentation& Interview,** Reflective Journal Due
8	Reflective Journal Due
10	Reflective Journal Due
12	Final Report Due, Process Report Due
13 – 14	*Assigned Study / Exam Weeks*
15	**Final Report – Presentation and Interview**

Table 3 –Timeline of important events

EVALUATION

The PBL model was evaluated using both student survey forms and student and staff focus groups. The latter were organized and hosted by an independent PBL expert. The survey form comprised a set of quantitative and qualitative questions and was completed by student participants from both 2013 and 2014. In total, there were 42 completed survey forms

received. Table 4 presents the average and standard deviation of the ratings given by the students for a range of statements, as shown. Students were asked to rate each statement on a scale of 1 (strongly disagree) to 5 (strongly agree).

Statement	Average rating (1–5)	Std. dev.
PBL Learning Experience		
PBL is an effective method of learning for me	4.33	0.72
PBL prepares me for my exams.	3.07	0.92
PBL prepares me for my future professional life.	4.51	0.55
PBL improves my teamwork skills.	4.48	0.77
PBL improves my written communication skills.	3.98	0.81
PBL improves my presentation skills.	4.50	0.51
PBL has motivated me to learn.	4.24	0.82
Facilitation		
I had good access to my facilitator.	4.38	0.70
I made good use of the access to my facilitator.	4.05	0.82
I have no difficulty in questioning my facilitator.	4.19	0.71
I am happy with the amount and type of feedback provided by my facilitator.	4.21	0.92
Physical Resources		
The physical environment is suitable for me to participate in PBL (eg. room, furniture, etc.)	4.38	0.58
There were adequate resources (software and hardware) available for your project work.	4.38	0.54

Table 4 –Survey results (42 responses) – 1 to 5 represents strongly disagree to strongly agree respectively

In general, students found the PBL experience very positive and rated it highly as a motivating and effective means of learning. As expected, they felt that PBL improved their communication, presentation and teamwork skills and better prepared them for their future professional life. Students were, for the most part, happy with their facilitator. However, it is worth noting the difference in rating between the two different sets of students for this category, as presented in Table 5. Clearly, the students in 2014 found the facilitation significantly better than the students in 2013 (i.e. the pilot version of PBL). This improvement is likely related to two key factors. Firstly, having been through a full cycle of PBL, the facilitators had gained invaluable experience of the process and were, subsequently, in a better

position to facilitate the second set of students. The second factor relates to improvements made in communication of the PBL process and the role of the facilitators to the students. The first cohort of students were not as well informed of the process as the second set of students, largely due to lack of experience of the participating staff at the time.

Statement	Average 2013	Average 2014
I had good access to my facilitator.	3.88	4.72
I made good use of the access to my facilitator.	3.41	4.48
I have no difficulty in questioning my facilitator.	3.88	4.40
I am happy with the amount and type of feedback provided by my facilitator.	3.47	4.72

Table 5 –Survey results on Facilitation

In terms of the qualitative student feedback and also that obtained from the focus group with the independent expert, there were some very insightful comments to support the above data. One student noted that "*PBL worked really well in the sense that it encourages students to be more liberated in terms of learning".* Another student stated that they "*liked working as part of a team".* It was something that they had *"never done before and found to be quite interesting".* Interestingly, a few of the students noted communication as an issue stating that they felt that "*the communication side of PBL was difficult. It was hard to communicate with everyone and even with the facilitators as"* they *"could be waiting a few days for a reply from an email."* One student noted that "*some of the team mates did not work and therefore put the team under pressure".* This issue was echoed by several other students also. In addition, many of the students felt that, as a group, they "*didn't always use the time constructively.*"

The facilitators found the PBL experience very different to their typical taught modules, but richly rewarding and enjoyable. They found the students to be significantly more motivated about their work and felt that the peer learning within the teams was a highly positive and worthwhile aspect of the PBL approach, noting that "*it was great to see groups of students working together as a team."* In particular, the facilitators enjoyed reading and examining the final reports, as it was far more interesting than the standard repetitive lab reports associated with conventionally taught modules. This was simply due to the fact that the PBL reports tended to contain new material and information that would not be found in a typical lab report. They also observed that it took time to get accustomed to facilitating as opposed to teaching and noted that "*not being able to get involved with the team and taking direction of the project was challenging at times*".

Overall, both facilitators and students found that the new style of learning through PBL was a

worthwhile model and were keen to see the learning process also integrated into later years of the BE in Electronic Engineering degree programme.

CONCLUSIONS

This paper has presented the implementation and evaluation of a PBL educational model in the form of a significant circuits-based project in a first year Electronic Engineering programme. Students found the experience challenging and time consuming but enjoyable, beneficial and ultimately a worthwhile exercise. The PBL model also provided the students with a valuable opportunity of experiencing a range of skills, including teamwork, leadership, communication, research, time management, and project management. The facilitators also enjoyed the experience and found that their students were significantly more motivated in their project work. Future work will consider the integration of the PBL educational model into later years of the BE programme.

ACKNOWLEDGMENTS

We wish to thank the Centre for Teaching and Learning at Maynooth University, Ireland and Prof. Lars Peter Jensen, Aalborg University, Denmark for their support and guidance on this project.

References

Biggs, J. (2003). Teaching for Quality Learning at University. 2nd ed., Buckingham: SRHE/Open University Press.

De Graaff, E. & Kolmos, A. (2003). Characteristics of Problem-Based Learning. *International Journal of Engineering Education*, 19(5), 657-662.

Hmelo, C. & Evensen, D. (2000). Problem-based Learning – a Research Perspective on Learning Interactions, Lawrence Erlbaum Associates Publications, London, 1-18.

Kjersdam, F. & Enemark, S. (1994). The Aalborg experiment: project innovation in university education. Aalborg: Aalborg University Press, 1994.

Kolmos, A. (1996). Reflection on Project Work and Problem-based Learning. *European Journal of Engineering Education*, 21(2), 141-148.

Savin-Baden, M. (2003). Facilitating Problem-based Learning: Illuminating Perspectives. *The society for Research into Higher Education & Open University Press*, Berkshire.

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 81-90
http://dx.doi.org/10.5278/ojs.jpblhe.v0i0.1227

Using PBL and Interactive Methods in Teaching Subjects in Medical Education

*Demikhova, N., Prykhodko, O., Loboda, A., Bumeister, V., Smiianov, V., Smiianov, Y., Lukianykhin, V, Demikhov, O.**

ABSTRACT

Nowadays information and telecommunication technologies are becoming more and more developed. It especially attracts and captures the young - young scientists, teachers and students.

The purpose of the article is to highlight the experience of implementing problem-based learning technology in the traditional system of teaching medical disciplines. We try to analyze the impact of the training project Tempus «Introduction of innovative teaching strategies in medical education and the development of the international network of national training centers" (530519-TEMPUS-1-2012-1-UK-TEMPUS-JPCR) on the quality of teaching students of medical specialty. A problem-based learning is used as an innovative educational technology in teaching biomedical disciplines. It includes problem-based learning (PBL), team training (team-based learning - TBL), interactive lectures (interactive engagement, peer instruction with clickers), discussion, training in cooperation (collaborative learning), cooperative learning [13].

We have come to the conclusion, that development and implementation of communicative, interactive problem-based learning system, which is characterized by

* Nadiia Demikhova, Sumy State University, Ukraine. E-mail: n.demyhova@med.sumdu.edu.ua
Olga Prykhodko, Sumy State University, Medical Institute, Ukraine. E-mail: olyastr1@yandex.ua
Andrii Loboda, Sumy State University, Medical Institute, Ukraine. E-mail: fafik1313@gmail.com
Valentina Bumeister, Sumy State University, Medical Institute, Ukraine. E-mail: vibumeister@mail.ru
Vladyslav Smiianov, Sumy State University, Medical Institute, Ukraine. E-mail: v.smiyanov@med.sumdu.edu.ua
Yevgen Smiianov, Sumy State University, Medical Institute, Ukraine. E-mail: sumylor@mail.ru
Vadym Lukianykhin, Sumy State University, Department of Management, Ukraine. E-mail: vadim.lukianykhin@ms.sumdu.ua
Oleksii Demikhov, Sumy State University, Department of Management, Ukraine. E-mail: o.demyhov@management.sumdu.edu.ua

practice-oriented approach, provides a reproducible stable planned results in practical terms with the formation of skills and abilities at the beds of the patients. It also helps self-organization and increases competitiveness of a person, who is able to adapt in a rapidly developing society.

Keywords: innovative technologies, medical education, PBL (problem-based learning) implementation.

FORMULATION OF THE PROBLEM

Nowadays information and telecommunication technologies are becoming more and more developed. It especially attracts and captures the young - young scientists, teachers and students. The Internet, various gadgets and mobile devices (laptops, pads, mobile phones) can not only provide interactive communication, but also create a powerful portal for finding and sharing information. These opportunities are penetrating deeper into our lives, including the system of education.

The reform of medical education in Ukraine is based on the competency approach to the skills formation. It allows to improve the quality of education of the graduates of medical educational institutions, but it requires new approaches to the educational process [9].
Using the traditional teaching strategy - from knowledge to problems - students can not master the skills of independent learning and scientific search, because they get final learning outcomes. In this case, there is a gap between theoretical knowledge and its practical application. In most cases, a student does not understand the necessity of learning basic disciplines (anatomy, histology, physiology, etc.) and can`t apply his/her knowledge in clinical practice. Consumption of "ready" scientific achievements can not form a model for future real activity in the minds of students. Therefore, in the future when they face nontrivial situation that requires implementation of their knowledge in a new field, they will not be prepared enough [13, 1, 3].

At this stage it is very important to teach students in close to real practical clinical situations, which university graduates will face in their future practice as doctors or pharmacists.

THE PURPOSE

To highlight the experience of implementing problem-based learning technology in the traditional system of teaching medical disciplines. We will also try to analyze the impact of the training project Tempus «Introduction of innovative teaching strategies in medical

education and the development of the international network of national training centers" (530519-TEMPUS-1-2012-1-UK-TEMPUS-JPCR) on the quality of teaching students of medical orientation.

Problem-based learning is used as an innovative educational technology in teaching biomedical disciplines. It includes problem-based learning (PBL), team training (team-based learning - TBL), interactive lectures (interactive engagement, peer instruction with clickers), discussion, training in cooperation (collaborative learning), cooperative learning.

BASIC MATERIAL

Problem-based learning is one of the main educational technologies used in teaching medical disciplines and biology. It is based on the system of clinical situations (cases) that gives a problematic situation to the group of students. In most cases it is not possible to explain a certain fact by using existing knowledge or perform a certain action using familiar standard methods. So it encourages students to find a new way to solve the problem. This need creates a motive, requires non-standard thinking and acting, that reflects the essence of problem-based learning. The highest level of the problem-based learning is when students during the school week set a problem themselves and solve it themselves.

The traditional system of medical education in Ukraine is based on holding lectures and practical (laboratory) classes. The central figure of this system is a teacher. Problem-based learning involves creation of problematic situations under the teacher`s guidance and active independent activity of students in order to solve them, resulting in creative mastering of professional knowledge, skills and abilities. A student is the central figure of such a model of learning. The task of the teacher (tutor) is only to correct the general learning direction and coordinate students' learning activity [7, 8, 11,12].

Science blogs

It is also important to conduct scientific blogging as a process of information exchange between scientists. Scientific blogs can gradually become an alternative to articles in journals (because of the speed of delivering information to the interested specialized scientists), expand their target audience and get actual reviews minded about their operating time. Research blogs are useful and interesting for young scientists and talented students who want to develop [8, 12].

Training project Tempus

Since 2012 Medical Institute of Sumy State University (SSU) has been a member of the implementation of the training project Tempus «Introduction of innovative educational strategies in medical education and development of the International network of national training centers" (530519-TEMPUS-1-2012-1-UK-TEMPUS-JPCR). Organization of

educational process based on credit system has allowed to adapt the curriculum in a relatively short period and integrate the elements of problem-based learning in it. 1,5 year training program-based on problem-based learning technology using clinical cases (case studies) provided by University of St. George (UK),is included in the 2nd and 3rd years of studying of the students of medical institute.

"Spiral" curriculum is formed in case of problem-based learning. It allows students to return to previously acquired knowledge, deepen it and obtain new one. This approach helps to use previously obtained knowledge and skills in a new clinical situation, to offer a new way of solving the problem by combining previously known elements, and also find unique solutions, which do not have existing analogues.

The newly created pilot program started in 2014-2015 academic year. During the first year 2nd course students should master 35 linear cases, during the second year (3rd course) – 18 branched cases that have interactive character that approximates the process of learning to real clinical situations. Interactive cases have been placed in an open-source platform for creating and playing virtual patients OpenLabyrinth (http://olab.zsmu.zp.ua/) with separate account for tutors and students. Tutors through own account can create or edit new cases, and students may work with these cases during the second year of PBL classes.

Actually, cases are is the form of integrated multi-situational tasks (complex tests, CCT), which are common in traditional medical education. Innovation is in the way of presenting the information about a patient to students and the ways of solving a problematic clinical situation.

Lesson structure

The main components of the lesson based on the problem-based learning technology are:

1) updating the knowledge of the basic subjects needed for solving a clinical situation;
2) analysis of the problematic task by discussing it in a group and comparison of your own opinion with the views of other team members, correction of their own point of view under the influence of reasonable proofs;
3) giving a number of assumptions with the help of team "brainstorming" and then narrowing the search field to determine the main problem;
4) formulation and the logical proof of working hypotheses by constructing a chain of causation;
5) checking the solutions. In case of ramified cases wrong tactics require to go a few steps back and review the basic hypothesis.

By oral questioning of students and checking their knowledge we have found out that the level of students` interest to learning increased, their motivational component increased, the

final results of teaching disciplines also increased. Thus, among the questioned students 80% gave a response that they like the proposed teaching model more; it is more convenient and useful for acquiring knowledge.

At the end of the course we proposed some interactive assessment cases for students and provided real-time testing though OpenLabyrinth. Final results were stored in the database, so that tutors and researchers could analyze students' answers with statistical methods (see table 1).

Table 1

Results of online assessment of PBL students in Open Labyrinth

	Score, % (M±m)	Total time for test, min	Average time per question, sec
PBL students, n=32	80.41 ± 1.87 p<0.01	29:45	31.9 ± 4.24 p<0.05
Comparison group, n=30	64.3 ± 4.27	39:55	48.21 ± 5.85

Notes: p – reliability relative to comparison group using Student's test

All PBL students passed testing successfully. Average mark grew by 16% compared to students who were not involved in PBL ($p<0.01$). All students passed testing in allotted time, the average total time of testing is 29:45 min. that is 10 min. less than in comparison group.
The average time per question (choice of answer) in PBL persons is less than in comparison group (see table 1). Most PBL students demonstrated the average time per question less than 20 sec and high final result which was about 80 points.

During the first year of the implementation of the pilot program 32 students learned on the basis of the new model, in the 2015-2016 academic year more than 60 people are studying on its basis and this process is getting widespread. Teachers have mentioned the improvement of the teaching conditions and, therefore, improvement of the students` learning results on such a streamlined basis.

Combination of the system of traditional teaching with elements of the problem-based learning is a reserve for further improvement of teaching students. Most teachers have refused to present material in the form of traditional lectures and thus have become consultants and coordinators of the educational process that allows students, working independently in small groups,to solve problems, give various hypotheses and seek the possibility of verification. The emphasis is not on memorizing and learning by heart, but on the analysis of the situation and its discussion with the active involvement of students in the process of meaningful, reasoned, conscious learning [2, 5, 6].

New requirements for teacher

So the problem-based learning has changed the role and function of the teacher. Mastering the skills of a tutor by the teachers of the Medical Institute of SSU occurred during training, conducted by the St. George University (UK), with the issuance of the certificates. It was necessary to understand that the main tasks of the teacher in terms of the problem-based learning are the following: creation of maximum positive emotions for students during the class, encouraging a student to use his intuition in combination with responsibility for decisions, stimulation of cognitive activity of students, informational supply of the educational process, monitoring of the correct direction of diagnostic search, etc.

Based on problem-based learning tasks, the new technique sets a number of requirements to the teacher: the joint search, based on the distribution of activities between students and a teacher; focus on the assessment of the possibilities of the students to determine the direction and content of the next stage of the search; tolerance to students` mistakes made while trying to find their own solutions; broad outlook, teacher`s erudition.

Application of the Herbartian theory

Our own experience shows that for the organization of problem-based learning a teacher has to overcome a number of difficulties: low motivation of some students, their indecisiveness and lack of activity, inability to distinguish significant aspects of the problematic task (clinical situation), attempts to use similar algorithms to solve different types of problems.

The practical Herbartian theory of education is interesting in this contex. In this theory the emphasis is placed on the didactic preparing of the teacher, his ability to think and "pedagogical tact." Thanks to J.-F. Herbart the question of "pedagogical tact" became the common heritage of pedagogical thinking and activity. In "Teaching Notes" ("Padagogische Schriften") (1802) it was found that pedagogical tact is produced in the process of teaching practice, through the influence on our feelings. Feelings, by J.-F. Herbart, are combined through mutual understanding between students and teachers through pedagogical influence. The scientist and his followers emphasised that the success or failure of any educational efforts depend on how the teacher "produces" his tact through his thinking, considering, research and scientific quality [4, 10].

Students should be gradually accustomed to the synthesis of knowledge and its application in practice. The following will be helpful: business games, "brainstorming" analysis of micro situations with a teacher, which are widely used in the Medical Institute of SSU, both in the problem-based and traditional learning.

But for such work a teacher himself must have developed skills and experience both as a physician and educator. A necessary condition for professional growth is teacher`s mandatory training abroad, which allows to get new experience, stimulate learning of foreign languages.

So the teacher must not only put a set of knowledge in the medical student, but move his process of thinking with the help of person-oriented approach to learning.

The introduction of ICT in education

Another condition for improving the quality of medical education is to introduce in the learning process new information, interactive telecommunication technologies which are widely applied in a problem-based learning.

Each class held basing on the methods of problem-based learning should be finished with a discussion of literature and resources needed to prepare for the case. As part of the Tempus project the only window of the virtual library was created on the platform of Microsoft Office 365. The portal provides access from any mobile device for all participants of the educational process (tutors, students) to educational materials that can be presented in Russian or English. In addition, the library allows you to post and use multimedia atlases, online banks of electrocardiograms, X-rays, tomograms, movies, elements of animated computer simulation in the educational process.

Remote technologies allow to get access to educational content independently from the location, help the organization of dynamic learning process. Creation of electronical educational devices(textbooks, lecture series, etc.) is important for implementation of these technologies. For this purpose an open access platform OpenCourseWare (OCW) (available at http://ocw.sumdu.edu.ua) was created in Sumy State University.

To create a high intensity of information flow for a limited period of airtime thanks to Lync Online it is possible to hold virtual "round tables", seminars and conferences for students and teachers. Also the device makes possible videotranslations of operations, manipulations and distance consulting of patients.

EXPANDING THIS SUBJECT

On the basis of such communication technologies (ICT), in order to attract medical students to the practical monitoring of patients, the University is creating a remote IT model in the form of automated program of patients` notice with two-way communication support. With the help of students we form information-analytical base. It has a function of reminding patients with arterial hypertension and feedback with a general practitioner of family medicine.

The proposed method of improving the quality of treatment of patients with arterial hypertension uses information-technical technologies. It allows to achieve improvement of

governance at the hospital, shortening of hospital treatment, deepening the quality of treatment and reduction of economic losses.

Thus, during the training students get involved in the implementation of information technology into the medical practice.

So information technologies help students to master knowledge faster, to operate mobile data sets and to be at the cutting edge of modern science.

Information technologies enable students to empirically explore new areas of knowledge and situationally simulate complex processes, perform calculations, get quick access to large volumes of data, process them using the methods of analysis and synthesis in order to achieve verificatory results.
Training of doctors at the transition to family and health insurance sets high demands to the knowledge of specialists. Family doctor should possess a great amount of knowledge, to be able to work with modern equipment, perform a series of manipulations, etc.
Application of knowledge and understanding, forming of judgments, communication skills and ability for lifelong learning are key competencies of the future doctor [The framework of qualifications for the European Higher Education Area [electronic resource]. - Access: http://www.ehea.info/Uploads/QF/050520_Framework_qualifications.pdf].

CONCLUSION

Problem-based learning allows you to master these competencies in the best possible way. It will allow to prepare a new generation of professionals who will perfectly master professional skills, will be able to learn constantly, grow professionally and adapt to the environment, quickly solve problems and obtain knowledge during all their professional lives.

Thus, development and implementation of the system of communicative, interactive problem-based learning, characterized by practice-oriented approach, provides a reproducible stable planned results in practical terms with the formation of skills and abilities at the beds of the patients, helps self-organization and increases competitiveness of a person, able to adapt in the conditions in society that is developing rapidly.

References

Andrushchenko V., Bodnar V., Vasyluk A. [Modernization of Teacher Education]. Vyshcha shkola [High School]. 2009: 9: 76–82. (In Ukrainian)

Grisham J.W., Martiniuk A. LC, Joel N. [Problem-Based Learning (PBL) and Public Health: An Initial Exploration of Perceptions of PBL in Vietnam]. EP Wright. Asia-Pacific Journal of Public Health, March 2015; vol. 27, 2: pp. NP2019-NP2027., first published on February 14, 2012, p.2019-2027.

Grudzinsky A.O. ["Group of Eight" on education]. Vysshee obrasovanie v Rossii [High Education in Russia]. 2009: 9: 66–71. (In Russian) *

Huemer W. University of Parma, Italy, Landerer C. University of Salzburg, Austria [Mathematics, experience and laboratories: Herbart's and Brentano's role in the rise of scientific psychology]. Jornal "History of the Human Sciences", 2010, #23(3) p.73-79.

Idowu Y., Muir E., Easton G. [Problem-based learning case writing by students based on early years clinical attachments: a focus group evaluation]. JRSM Open, March 2016: vol. 7, p.1-8.

Johnson M., Hayes M.J. [A comparison of problem-based and didactic learning pedagogies on an electronics engineering course]. International Journal of Electrical Engineering Education, January 2016; vol. 53, 1: pp. 3-22., first published on July 23, 2015, p.1-20.

Kaloshin V., Gumenyuk D., Lutsenko Y. [Pedagogy of success: Theory and Practice]. Kiev, 2011: 194pp. (In Ukrainian)

Kerawalla L, Minocha Sh, Kirkup G, Conole G [An empirically grounded framework to guide blogging in higher education]. Research in Learning Technology, Suppl.: ALT-C. 2012:176-188. (In English) **

Kovalchuk L.Y. [Results of implementation latest techniques educational process in Ternopil state medical university and plans for the future]. Medichna osvita [Medical Education]. 2012: 2: 11-17. (In Ukrainian)

Neumann E., Kiss A., Fejes I., Bajomi I., Berényi E., Biró Z.A., Vida J. [The Hard Work of Interpretation: The National Politics of PISA Reception in Hungary and Romania]. European Educational Research Journal, June 2012; vol. 11, 2: pp. 227-242.

Stetsenko G [Problems introduction web technologies in higher pedagogical educational institutions]. Higher Education Pedagogy: methodology, theory and technology. Kiev: Gnosis, 2009: 630 pp.: 569 - 572. (In Ukrainian)

Xie Y., Fengfeng K., Sharma P. [The effect of peer feedback for blogging on college students' reflective learning processes]. The Internet and Higher Education. 2008: 11: 18-25. (In English)

Realising the European Higher Education Area [Communiqué of the Conference of European Ministers about training specialists]. Berlin, 16–19 Sep, 2003: 28–30. (In English)

Comments:

***** is about applying new pedagogical strategy in Russian high education (include Medical education).

****** is also an important issue is to conduct scientific blogging as a process of exchange of information and good ideas among scientists. Science blogs can gradually become an alternative to articles in journals in the context of the speed of delivering information to the interested specialized scientists, expand its target audience and getting actual reviews minded about their operating time. Research blogs are useful and interesting for the young scientist and prospective students who want to develop.

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 91-99
http://dx.doi.org/10.5278/ojs.jpblhe.v0i0.1135

Fundraising Strategies Developed by MBA Students in Project-Based Learning Courses

*Joao Alberto Arantes do Amaral, Liége Mariel Petroni, Aurélio Hess **

ABSTRACT

The ability to raise funds is a skill that most modern project managers need. While a good deal of literature exists on the strategies NGOs employ to raise funds for their operations, less attention has been paid to the strategies used by students involved in Project-Based Learning courses that often partner with NGOs. Fundraising is an important skill that not only provides students with opportunities for creativity, but also helps them develop the communication skills they will need in the work they do after they graduate.In this paper, we discuss the fundraising strategies developed by MBA students in 204 social projects completed between 2002 and 2014. The projects were done in partnership with 39 community partners in Sao Paulo, Brazil (NGOs and Public Institutions). In our study, we followed quantitative and qualitative research methods, analyzing data and documents from the projects' databases. We identified six different fundraising strategies: organizing raffles, soliciting donations from private corporations, organizing paying events, utilizing online social networks developing crowdfunding, and soliciting individual donations.

Keywords: Fundraising strategies, Project-Based learning, Project Management, Higher education.

DESCRIPTION OF CONTEXT

* Joao Alberto Arantes do Amaral, Federal University of Sao Paulo – Unifesp Osasco, Brazil.
Email: jarantes@alum.mit.edu
Liége Mariel Petroni, Federal University of Sao Paulo – Unifesp Osasco, Brazil.
Email: lmpetroni@uol.com.br
Aurélio Hess, INOVATA-FDTE Engenharia, Faculdades Osvaldo Cruz, Escola Técnica e Colégio
Email: hessaurelio@gmail.com

From 2002 to 2014, the first author was a professor in the Project Management MBA offered by University of Sao Paulo, teaching the course "Project Simulation." He used Project-Based Learning (PBL) methods in this course, which he taught forty-seven times over the course of twelve years. In total, the experience involved approximately 1,400 students and 39 community partners.

The MBA students were professionals with backgrounds primarily in business, engineering and information technology. All had at least five years of working experience.
In our PBL course, we worked closely with community partners who serve poor and disadvantaged people. These included NGOs and public institutions that help children and teenagers from poor families, orphans, abandoned elders, victims of sexual abuse, people suffering from disease (mainly cancer) and those with mental problems.

The community partners had real-world needs that they presented to us as "project themes". The students chose a project theme and then worked in teams of five people, on average. Sometimes the institutions needed goods such as furniture, books, toys, or blankets. Occasionally they needed small repairs to be carried out on their facilities -- floor replacement, bathroom modifications, windows replacement, painting and so on. In other instances the community partners needed the creation of products such as websites, booklets or even databases. Now and then the partners needed help in improvement of their internal procedures. When this occurred, the students developed a consultancy project. Some project themes led the students to perform fundraising activities, while others did not.

We consider the ability to raise funds for a project is an important for our students. In the future, many of our students may work for NGOs, where the project managers are required to perform fundraising activities for the projects they work on. More than that, fundraising is a challenge: it offers the students the opportunity to develop creativity by finding strategies for obtaining resources for their projects. In addition, the fundraising activities provide opportunities for students to interact with private corporations, NGOs, and community members, intereractions that help students improve their communication skills. Finally, fundraising is very important for our community partners, who use the funds raised by our students to continue their missions. It is a win-win situation: the students improve their skills empowering the community partners, consequently bringing benefits to the people assisted by them. This virtuous circle motivates the community partners to maintain theirs partnerships with the university.

THEORETICAL FRAMEWORK

Engaging students to work with the community is now part of university education (Carter et. Al, 2002). However, the creation of partnerships between universities and community partners is not easily accomplished. Although a partnership may bring benefits to both sides, it can involve tensions and conflicts (Strier, 2014). In addition to that, Dulmus & Cristalli (2011, p.2) ponder that university-community partnerships join together partners with diverse skills, knowledge, and expertise. According to Norris et. al. (2007, p. 27):

> Building relationships and effective collaboration require time, patience, physical presence, respect, and commitment—elements frequently in short supply in a busy academic environment.

Kennedy (1999, p. 197) reports that university-community partnerships can range from simple, low-cost projects to multiyear, grant-funded initiatives. Partnerships can bring benefits and opportunity to all involved (Buys & Bursnall, 2007)(Sandy & Holland, 2006). As Striers notes (2014, p.155):

> Both universities and communities see these joint ventures as opportunities to achieve different goals. Universities see them as expressions of 'engaged scholarship', by means of which academic institutions can reinvigorate their academic missions. For their part, communities look at these enterprises as means to advance their social agendas.

One way of advancing the social agenda of community partners is to provide the material and equipment they need to work better. Academic projects with fundraising activities can be a good way of developing the project management skills of the students and strengthening the community partners.

Models and theories about project fundraising abound on the literature on NGOs (Pereira, 2001), (de Camargo, 2002). NGOs usually raise funds from individuals, companies, foundations (national and international), churches, governments, and by holding events (Cruz & Estraviz, 2000). NGOs create fundraising action plans and follow them in a systematic way, establishing goals and monitoring and controlling the activities developed in order to reach those goals. Although the aforementioned literature covers the different aspects of fundraising in the context of projects accomplished by NGOs, there is a lack of information about fundraising activities accomplished by students, in the context of university-NGOs partnerships developed in PBL courses. This case study aims to address this lack.

CONCRETE IMPLEMENTATION AND ACTIONS

During our courses, we allowed the students to have voice and choice. They were free to choose the project theme from any community partner. The students were also free to choose the fundraising strategy they considered to be most adequate to the problem they faced. In this case study we will focus on six fundraising activities performed by the students:

1. Organizing raffles
2. Obtaining donations from companies
3. Organizing events
4. Using online social networks
5. Crowdfunding
6. Asking individuals directly for donations

We will present each strategy and provide examples of how each was incorporated into the project.

Strategy one: Organizing raffles

Selling raffles tickets was, by far, the strategy that students liked most. Selling raffle tickets is easy to manage: students can plan the number of necessary tickets and establish sales goals for each team member. While this is a low risk strategy, it is an activity that is time consuming and labor intensive. The individual results of these activities usually depend on the personal network of each team member. Some team members were able to sell their share of tickets rapidly and even help the others to sell theirs. Other students had problems meeting the goals they had set.

One good example of use of this strategy occurred in project done for the benefit of an orphanage. The orphanage needed a mini-van to transport children between their facilities to the schools. In Brazil, the price of vehicles is very high, because of taxes. In order to obtain the necessary funds, the students organized a series of raffles, with clearly-defined sales goals. Using this strategy, they raised the money they needed.

Strategy two: Obtaining donations from private corporations.

This strategy was very effective. Students obtained donations from both big companies, and pools of smaller companies. We will give a few examples of how it worked.

In one project, the students formally asked for support of a big company in the automotive industry. They followed the internal procedures of this company, presenting the project's objectives, the needs of the client and all information the company required. The students asked for a donation of approximately 2,500 dollars. The social responsibility department of the company analyzed the request carefully. They set up meetings with the students, asked for more detailed information about project and wanted to know the steps that the students would

take if the resources were given. Satisfied with the information they received, the company decided to give the students approximately three times the amount asked. The only condition was that the students should talk to the NGO in order to increase the project's scope.

In another project, the students were working with the hemophilia team (doctors, social workers, nurses, psychologists and physiotherapists) of the hospital of the University of São Paulo. It was a complex project: the students were challenged to organize a set of educational activities with patients (hemophiliac children) and the hemophilia team, in a camping event that would last one weekend. There were multiple needs: the students had to find a suitable place, obtain the means of transportation, provide food, bed linens, toothpaste and toothbrushes, and towels to the patients. The students approached a pool of companies. One company provided the camping location, a small farm with lodges and sport facilities (swimming pool, ball courts) and classrooms. Another company provided one bus to transport the students, the patients, and the hemophilia team. Two other companies provided the food and the linens.

One very interesting project was accomplished by a project team that worked with an NGO that helps the homeless. The NGO welcomes the homeless and shelters them on a farm where they receive all necessary assistance: food, medical treatment, work orientation, clothes, psychological support and treatment for addiction. The NGO asked students for one ton of food, enough to support one month of their activities. The students developed a partnership with a supermarket. They proposed a win-win situation: the students would help the supermarket to improve the sales of its products, asking the clients to buy an additional amount of food for the NGO. In exchange, the supermarket would help the students to obtain donations of food. The whole action was accomplished in one weekend. The supermarket used an announcer to publicize quick promotions. The agreement with the students was that this announcer would also mention the students' projects and their needs. After the customers checked out, students would request donations from them. In this project, everyone involved won: the supermarket customers, eager to participate in social projects, we able to do it in a simple way, by donating a small amount of food. The supermarket improved its sales. The students collected not merely one ton of food, but seven.

Several other projects involved donations from small companies. For example, in one project the students were able to obtain the donation of a sewing machine. In another project, the students received the donation of several used computers from a school. In another project the students received donations of books from public libraries and from private schools.

Strategy three: organizing events

This strategy is very interesting, for it worked as a project within a project. We will illustrate with few examples.

In one project, the students chose to help an orphanage. The institution needed money to finish a major building repair. The students wanted to help, but also wanted to have some fun doing so. They contacted a live music bar and offered a partnership. One of the students on this project team was a member of a band. The band proposed to the bar owner that they would play for free one Saturday night in the bar. In exchange, the bar owners would give the team half the money earned from this show. That was memorable night: the students obtained the necessary resources and had a lot of fun doing so.

In another project, the students wanted to help a retirement home for abandoned elders. The institution needed to provide each elder with a kit of hygiene products (shampoo, toothpaste, deodorant, soap, toothbrush, moisturizing creams, body powder). The students decided to organize an "Project Management Workshop".The students divulged the workshop to their colleagues of work. The students exchanged workshops' entrance tickets by material donation. They also received help from a bank that provided for free an auditorium for workshop's realization. This strategy worked as planned, an the project was a success.

Another interesting project involved the realization of a party. In Brazil, during the months of June and July, there are traditional festivals called "June Parties." The participants at those parties traditionally dress in festive clothes and eat traditional food. The students decided to create a June Party and sold tickets.The project achieved its goals.

A similar idea was followed by another team, who set up a formal dinner, and sold tickets to the event.

Strategy four: Using online social networks

In recent years, the students have used online social networks such as Facebook as a source of donations. The results varied: some groups obtained part of the resources they needed, while others did not. The outcome has to do with the strength of the connections that each student had. However, the best results came when students disseminated information about the project on social networks but asked for resources in face-to-face meetings.

Strategy five: Crowdfunding

The use of crowdfunding has not worked so far. When the students followed this strategy they did not obtain the necessary funds. It may be that since the projects they worked on lasted only twelve weeks, time was too short to rely on crowdfunding alone. The crowdfunding organizations that students chose to work with usually needed more than 12 weeks to analyze the project and to provide the necessary funds. The students have not yet found crowdfunding organizations that can help meet the projects'demands.

Strategy six: Asking directly for donations from individuals

In some projects, the students decided not to spend time organizing raffles but asked directly for donations from wealthy or powerful people within their social networks. Together, the students created a list of potential donors and developed an approach strategy. The students contacted the potential donors directly, by setting meetings. During the meetings the students formally presented their project, describing the actions of the NGOs on behalf of people in need and explaining the benefits of the partnerships between the NGOs and the university. They also presented the project's blog, talked about the results achieved so far, and then, at the end of meeting, gently asked if the potential donor would like to contribute to the project. This strategy has worked very well.

RESULTS AND DISCUSSION

Between 2002 and 2014 we accomplished 204 projects. In 76 projects, raffles were the primary fundraising activity. In 68 projects the students obtained the resources they needed from donations of companies, and in 50 projects the resources came from individual donations. Ten projects were accomplished using resources obtained from events. In many projects, however, the students used more than one strategy. We estimate the projects brought to NGOs approximately half million of dollars in goods and services.

Analyzing the fundraising results, we can say that all strategies worked effectively except for the strategy of crowd funding.

REFLECTIONS

Reflecting on our experience and analyzing the data we have collected, we can share with the PBL community ten lessons learned:

1. Give freedom to the students to follow the fundraising strategy they prefer. The students should develop their strategy by themselves; it is part of the learning process.
2. Provide the students with the information (documents, pictures, videos) about previous years' projects. In our experiment, the students had access to previous years' documents, available in blogs created by teams of students who had preceded them. It is important for students to learn about prior strategies followed and the results achieved.
3. Reserve one lecture only to discuss with the students the previous years' strategies. One lecture can give them ideas and reduce their anxiety and tension about the project they are doing.

4. Encourage the students to use more than one fundraising strategy simultaneously. The combined use of strategies reduces the probability of failure, especially if one strategy does not work successfully.
5. Pay attention to the community partner's expectations of the project's scope. Over-ambitious estimates could generate tension between students and partners.
6. Create an official letter in the name of the university that students can give to potential donors. This letter should inform donors that the students are working on academic projects and that all resources obtained will be designated to institutions that work with people in need.
7. Ask the community partners to bring project some themes that do not require fundraising. This is important, because the students should not be obliged to work in fundraising if they do not feel comfortable with it.
8. Discuss with community partners which topics are appropriate for projects. Very simple themes should be avoided.
9. Ask the community partners to establish an order of priorities for the topics proposed to the students. In other words, the most urgent needs should be on the top of the project theme list.
10. Challenge the students to choose the more difficult projects. In our experience, the students learn more when face complex fundraising and other challenges.

CONCLUSION

Fundraising is a very important skill of modern project managers. Project management courses should give students the opportunity to develop these abilities. Working with NGOs that help people in need was a good way to provide the students with a valuable educational experience while at the same time developing their social conscience.

References

Bushouse, B. K. (2005). Community Nonprofit Organizations and Service-Learning: Resource Constraints to Building Partnerships with Universities. *Michigan Journal of Community Service Learning*, *12*(1), 32-40.

Buys, N., & Bursnall, S. (2007). Establishing university–community partnerships: Processes and benefits. *Journal of Higher Education Policy and Management*, *29*(1), 73-86.

Carter, M., Rivero, E., Cadge, W., & Curran, S. (2002). Designing your community-based learning project: Five questions to ask about your pedagogical and participatory goals. *Teaching Sociology*, 158-173.

Cruz, C. M., & Estraviz, M. (2000). Captaçäo de diferentes recursos para organizaçöes sem fins lucrativos (Fundraising for NGOs). Global.

da Silva, E. P. C., de Vasconcelos, S. S., & Normanha Filho, M. A. (2011). Organizações do terceiro setor: desafios na captação de recursos para sua gestão (Third sector organizations: the challenges of fundraising). *Revista da Ciência da Administração*, *1*.

Dulmus, C. N., & Cristalli, M. E. (2011). A university–community partnership to advance research in practice settings: the HUB research model. *Research on Social Work Practice*, 1049731511423026.

Kennedy, E. M. (1999). University-community partnerships: A mutually beneficial effort to aid community development and improve academic learning opportunities. *Applied Developmental Science*, *3*(4), 197-198.

Mobley, C. (2007). Breaking Ground Engaging Undergraduates in Social Change Through Service Learning. *Teaching Sociology*, *35*(2), 125-137.

Norris, K. C., Brusuelas, R., Jones, L., Miranda, J., Duru, O. K., & Mangione, C. M. (2007). Partnering with community-based organizations: an academic institution's evolving perspective. *system*, *5*, 8.

Pereira, C. (2001). Captação de recursos: fund raising: conhecendo melhor porque as pessoas contribuem (Fundraising: understanding why people contribute) . Editora Mackenzie.

Sandy, M., & Holland, B. A. (2006). Different Worlds and Common Ground: Community Partner Perspectives on Campus-Community Partnerships. *Michigan Journal of Community Service Learning*, *13*(1), 30-43.

Strier, R. (2014). Fields of paradox: university–community partnerships. *Higher Education*, *68*(2), 155-165.

Journal of Problem Based Learning in Higher Education

VOL. 4, No. 1, 2016 – Page 100-108
http://dx.doi.org/10.5278/ojs.jpblhe.v4i1.1425

Voices from The Field: Developing Employability Skills for Archaeological Students Using a Project Based Learning Approach

Gaynor Wood *

ABSTRACT

Graduate employment statistics are receiving considerable attention in UK universities. This paper looks at how a wide range of employability attributes can be developed with students, through the innovative use of the Project Based Learning (PjBL) approach. The case study discussed here involves a group of archaeology students from the University of Central Lancashire (UCLAN) and their task of reconstructing and firing a small, early medieval clamp kiln. The employability skills and attributes are discussed, with reference to Yorke's Understanding, Skills, Efficacy and Metacognition (USEM) model of employability.

Thanks are due to Get Your Wellies Outdoor Learning Centre, Preston, Lancashire for the use of their site, and to five students James Claydon, Brian Joynes, Josh Pugh, Dan Scully, Mike Woods, and two community volunteers, Bernard and Pat Fleming, for their involvement in the experiment.

INTRODUCTION

Within the current UK archaeology and heritage sector the competition for jobs is fierce and students need a complex set of skills and personal attributes to attract a potential employer. In the latest Institute of Field Archaeologists survey (Aitchison and Edwards, 2008, p.106) employers said as well as field skills, new entrants also needed experience in project management, people management and problem solving.

* Gaynor Wood, University of Central Lancashire, Centre for Excellence in Teaching and Learning.
E-mail: gwood1@uclan.ac.uk

DEFINING EMPLOYABILITY

In this paper, employability is a "a set of achievements – skills, understandings and personal attributes – that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy." (Yorke, 2006, p.3). This definition moves away from merely listing key, core, or specific skills that students need to demonstrate (Hillage and Pollard, 1998) Dacre Pool and Sewell, (2007). Employability becomes a more complex and richer idea involving, "a mix of personal qualities and beliefs, understandings, skilful practices and the ability to reflect productively on experience."(Yorke, 2006, p.13.)

Yorke's USEM model is nonlinear and features four interrelated components: understanding, skills, efficacy, and metacognition. Figure 1 shows the major influence of the E (efficacy) component.

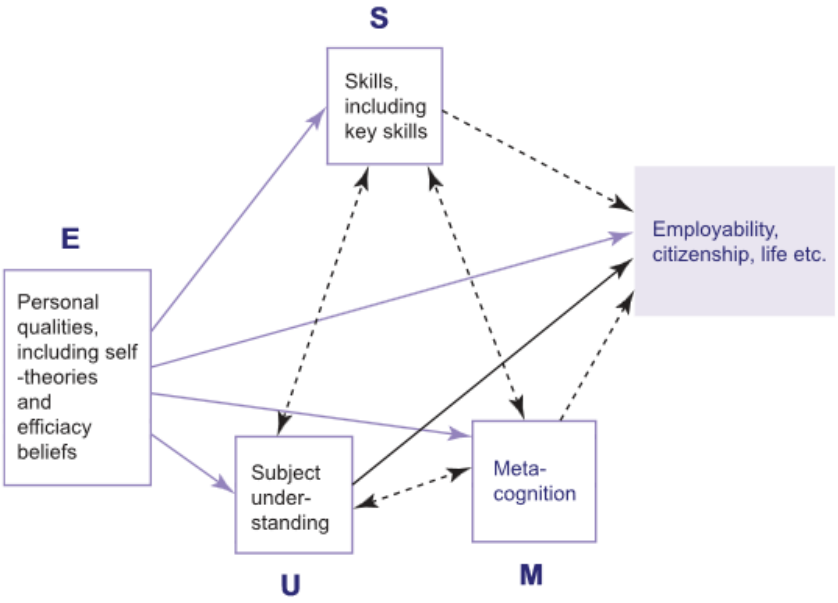

Figure 1. *'The USEM Employability Model* (Yorke, 2006)

Using complex pedagogies such PBL and PjBL.

Within a constructivist model such as USEM, students develop their own understanding and explanation through an experiential approach, which allows the learner to analyse, test and to develop their learning. PBL and PjBL (Project Based Learning) exercises are vehicles which encourage and support students to do this.

PBL and PjBL have been used in some UK archaeology departments to teach specific modules, for example, McGuire (2008) Enquiry Based Learning in Level Archaeology at Glasgow University and Wood (2010) "Athens, Empire and the Classical World*"* at Sheffield

University. University College, Dublin has delivers a major part of its experimental archaeology degree programme through PjBL.

Defining PBL and PjBL

PBL and PjBL are pedagogies which come under the umbrella term for self-directed enquiry known as Enquiry Based Learning. (EBL). PBL is defined by Savary (2006) as "a learner centred approach that learners use to conduct research, theory and practice and apply skills and knowledge to develop a viable solution to a problem." (p. 12).

Donnelly and Fitzmaurice view PjBL as product driven, "an individual or group activity that goes on over a period of time, resulting in a product, presentation, or performance. It typically has a time line and milestones, and other aspects of formative evaluation as the project proceeds."(2005, p. 3). Savin Baden (2007) defines PjBL as "predominately task orientated…. students are required to produce a solution or strategy to solve the problem (and) are required to produce an outcome in the form of a report or design…"(p.18).

In a PjBL exercise based on the archaeological study of pottery kilns design and development, the research problem might be very structured, "How do we design and build a small kiln which can be used to fire pottery?" In this example, the building and firing of a kiln are the focus of sustained inquiry and reflection.

For a study looking at the difficulties of recognising kilns and pottery manufacturing sites in the archaeological evidence, a PBL scenario might be, "you have been asked to revisit pottery production site excavated in the later 1900's and review the unpublished excavation report. There are some sketches, and the excavator's notes but no overall site plan. You must identify the major features of the site, including the kiln."

The following case study was devised as a PjBL exercise because project management was a key skill that employers in the Institute of Field Archaeologists survey felt were missing in many archaeology graduates. (Aitchison and Edwards, 2008, p.110). In the real world, archaeologists have to work as teams on clearly defined projects that have specific outcomes and are time, resources and scope constrained. Project management, therefore, concerns the application of skills and knowledge to meet the requirements of the chosen project successfully. This project was designed to meet three outcomes: the practicalities of managing the build and successful firing of a small kiln, answering a research question, and lastly, some reflection upon the personal learning that has taken place during the activities.

CASE STUDY: INVESTIGATING THE EVIDENCE LEFT IN THE ARCHAEOLOGICAL RECORD BY A SMALL CLAMP KILN

This experiment was structured over twenty two hours of contact time and was a voluntary activity undertaken by five, third year students from the archaeology department at UCLAN. They could use the activity to count as part of their required hours of fieldwork but these were final year students, who had already completed this requirement.

The PjBL process

Session One: Introducing the trigger and deciding on the research question (classroom based).

Archaeology students need a working knowledge of main pottery types and pottery production; so that they are able to recognise and date artefacts and structures during their independent student initiated summer fieldwork and staff initiated excavations. From their first year Introduction to Archaeology module, and from their subsequent excavation experience, the students recognised pottery's importance for dating purposes, and could identify basic pottery types. This exercise reinforced learning that students already had acquired in the classroom, and during their field work.

For this exercise, the trigger was a portfolio of excavated evidence containing a photograph of an excavated kiln from excavations at Norton Priory, Cheshire, and a video of experimental kiln firings at Butser Ancient Farm. After a group discussion our research question became, "what kind of evidence does the building and single firing of a small kiln leave in the archaeological record? "

Sessions Two and Three: Designing the experiment (classroom based.)

The students had no experience of the pottery production process or kiln technology, so they had to do some considerable research on the process and the practicalities of this. Outside the tutorial students were encouraged to work independently on gathering more information, and developing ideas which they then share with the rest of the group. They brought in excavation photographs and drawings they had discovered, sketched their designs out and argued the pros and cons of each design.

The group decided that the kiln structure should be simple and easy to build. There is archaeological evidence of this practice that has been found on Roman and Iron Age settlements sites.

Session Four: Making pottery (classroom based)

Our research question was based around firing a kiln that was loaded with pots. Pots can explode during the fire process for a variety of reasons: they are poorly made and contain air pockets, are too wet when fired, or suffer thermal shock, and these broken pots might leave recognisable shards in the ashes of the kiln. The volunteers made twenty eight unglazed pots of differing sizes.

Session Five: Building and Firing the Kiln (field work)

We spent a day building the kiln and firing the kiln. We dug a small pit in which a fire was lit and allowed to burn to embers. Our pots were laid on the embers and covered with more wood and turves to seal the kiln. The firing took place over twelve hours.

Session Six: Excavating the kiln (field work)

We returned a week later and spent the day excavating the kiln. Around twenty four of the pots had fired successfully. We excavated the firing pit but found little evidence that would distinguish this from a domestic hearth.

PROJECT EVALUATION

The students were asked to attend a final classroom session to reflect on their activities and contribution to the experiment, guided by a series of semi structured questions.

Relation of Students comments to the USEM employability model.
This section details comments that came from our discussion of the project and what the students thought about the activity and their own personal learning.

- U Understanding: subject knowledge; its comprehension and applicability

This project, based around ceramics, was designed to promote students understanding about experimental work, and the process of research. One student felt that this was a very personal piece of exploration, (It's all about) testing of provable hypothesis so you will start out with a research question and instead of book bashing and going to the library and regurgitating other peoples' nonsense, you are going out an actually creating something to try and bridge the gap between the known and the unknown.

They understood that even after their planning, the kiln might fail, but their research still had meaning,

I don't think it's actually what's produced ... because if everything is broken, the write-up could still be sound, because what it would say is what I believe is the problem is that we did this, we did that, we did this wrong....it still makes the experiment legitimate, because you are justifying something that you shouldn't do…you still find something out.

Undergraduate students usually only start designing research questions with their third dissertation topic, and it is rarely that they are in a research partnership with a member of staff,

It's not you saying here is what you have to do, go and do it, here's all the reading, go; it's actually promoting real thinking. So not Googling something and then copying it into a text, you know, there's your essay ... It's actually thinking about stuff, it's like, for the challenges you have.

- S Skills: skilful practice, the deployment of skills

The discussion on skills development is driving the employability agenda in Higher Education. However it is not just acquiring skills that is important, it is recognising the skills that you actually have running (the project) in small groups exactly we've done it then it promotes team work as well, which is again, one of your employability skills.*"*

Being competent at field work was recognised as being important and a source of pride in some, "it's the practical skills that are of benefit to you, so whether it's sieving in a lab or it's making pots or whether it's getting your hands dirty digging."

There was also recognition of developing a more specialised skill in pottery making,
So not only can I tell what kind of pot and the age of the pot from a little tiny piece, I can also recreate that pot, I can make it as it was...it will also help you when you are drawing it. People take shards and they draw the cross sections and they say right, we know this from that. You are going to be quicker with that because you will be able to tell right away that it's definitely not wheel thrown, for example.

- E Efficacy: seeing opportunities for learning, personal commitment, believe in own efficacy when faced with challenges

One of the largest challenges for the students was not so much the design or the excavation of the kiln, but making the pottery to fire. They found out that they actually enjoyed learning how to make pots, "you can read about something, the process and its fine and you might learn something I mean we probably have a better understanding than anyone on our course about how to create pottery."

And, "now that I have actually made it, I have a new found respect for it, and when I find the pottery I will have the experience of what we have done in my mind and that will help".
The students also developed a new found sense of competence. We had been allowed to build our kiln on some spare ground at a local business which taught some archaeological skills to school children. One of the student mused on the possibility of getting a part time job with the company because he now had the skills and the confidence to teach people to make ceramics, *"*now I can pretty much make these pots and now show someone how to do (it) and then fire a kiln."

- M Metacognition: self-awareness of own learning, reflection

Clearly this experiment had been a very different learning experience to what the students had had previously. To encourage further reflection, we discussed the concept of "soul authorship" (Schindler, 2015). Schindler thinks that through active and authentic learning experiences, such as making and using building tools or structures, we can encourage archaeology students to make a deeper and more thoughtful connection with the past. He feels that this gives his student real ownership of the teaching and learning experience. The students reflected on this; they understood the concept and could relate to it.

Doing this brings out new respect for the past. We were talking a bit before about you know that soul ownership…a lot of people do argue that personal connection with the things that you do dig up is very nice whatever, but to actually make stuff, you do have a personal relationship with what you are doing ...if it's making pots, or building a granary or a roundhouse or a kiln.

They recognised they were thinking about archaeology in a different way. This soul thing with the pot, linking us to that bit of pot ...I think it goes further than that, because you are also linking yourself to the person that has made the same kind of thing…you kind of get a bit of an attachment don't you ...to that person, like, you know in the past. They have had to go through the same stuff we have had to do to get this. Is it going to get up to temperature? Is it going to keep to temperature? Is anything going to come out of it?

And sometimes that we can, as archaeologists, reflect on our relationship with the past, "and when I saw the Oxford North pot with a thumb print in it...that is a real kind of connection. That is a moment in time stopped there, and it stopped with the pot being made"

CONCLUSIONS

Both pure and hybrid PBL and PjBL approaches have been used successfully within the archaeological curricula at several universities because time, resources, interest, expertise with the curriculum and appropriate managerial support, were available within their Department or School to do this.

For other university departments where such approaches are not yet used, it is suggested here that the PjBL approach could be trialled and used within one module of an archaeological degree course to ascertain student interest, and if it has been of benefit in developing their employability skills. If successful, a PjBL exercise could be developed to as a replacement for, or addition to, a course's requirement for excavation and field work, or even an option for a traditional dissertation.

PBL and PjBL are, of course, only two elements in the lecturer's personal teaching tool kit. We could try to develop some space within our own teaching to explore alternative approaches to learning with our students. Here, in this personal and safe space, we can try to enhance our students' learning experiences, and help them to develop and articulate the employability skills and attributes which are demanded of them in the "real" world.

References

Aitchison, K. & Edwards, R. (2008). *Archaeological labour market intelligence: profiling the profession.* 2007- 08. Reading**:** IFA.

Dacre Pool, L. & Sewell, P.J. (2007). The key to employability*:* developing a practical model of graduate employability. *Education and Training, 49* (4), pp227 -289.

Donnelly, R. & Fitzmaurice, M. (2005) Collaborative project-based learning and problem-based learning in Higher Education: a consideration of tutor and student role in learner-focused strategies. In G. O'Neill, S. Moore & B. McMullin (Eds) *Emerging issues in the practice of university learning and teaching* (pp.87-98). Dublin, AISHE/HEA.

Hillage, J. & Pollard, E. (1998). *Employability: developing a framework for policy analysis*. London: DfEE.

Yorke, M. & Knight, P. T. (2006). *Learning and employability Series 1: embedding employability into the curriculum.* [Online]. Available from: http://www.employability.ed.ac.uk/documents/Staff/HEABriefings/ESECT-3-Embedding_employability_into_curriculum.pdf. Accessed 1 February 2016.

Musty, J. (1974). Medieval pottery kilns. In Evison, V I, Hodges, H, & J. G. Hurst (Eds), *Medieval pottery from excavations: studies presented to Gerald Clough Dunning*. London: John Baker. pp 41- 65.

McGuire, E.L.H. *(2008)* Students and their digs: enquiry-based learning in level-one archaeology. *Practice and evidence of the scholarship of teaching and learning in higher education*, (3) 1.pp. 84-101.

Savery, J. R. (2006). Overview of problem-based learning: definitions and distinctions. *Essential readings in problem-based learning: exploring and extending the legacy of Howard S. Barrows*, pp.5-15.

Savin Baden, M. (2007) Challenging models and perspectives of problem based learning. In Graaff, E & Kolmos, A. (Eds), *Management of Change*. pp. 9–29. [Online]. Available from: http://www.control.auc.dk/~lpj/PBL/Management-of-change%20-Ch1-2printable.pdf#page=19. [Accessed 6 June 2016].

Schindler, W (2015). *Soul Authorship and the value of authentic learning experiences in higher education pedagogy.* Paper presented at the 9th Experimental Archaeology Conference (EAC9), (*Dublin*). [Online] Available from: https://www.youtube.com/watch?v=LcQNhCm_k2c [Accessed 1 February 2016].

Thomas, J. W. (2000). *A review of research on project-based learning*. [Online]. Available from: http://www.k12reform.org/foundation/pbl/research. [Accessed 1 February 2016].

Yorke, M. (2006). *Employability in higher education*. Raabe Academic Publishers.

Wood, J. (2010) Inquiry based learning in the arts: a meta analytical study. [Online]. Available from: *https://www.sheffield.ac.uk/polopoly_fs/1.../IBL_in_Arts-FINAL.pd. Accessed 1*