

## Application of Problem-Based Learning in Classroom Activities and Multimedia

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*Abstract: Problem-based learning (PBL) provides real-world, purposeful interactions to help graduate and undergraduate students learn how to work with and learn from a diverse group of people laterally and horizontally within a learning community. At the same time, information technology in the 21<sup>st</sup> century provides the opportunity to integrate learner support into PBL learning environments. PBL and technology provide the opportunity for communities to grow and learn together. Various types of activities implementing PBL shape the classroom activities and reform the roles and duties of undergraduates and teachers as well. This paper deals with the opportunities for undergraduate and graduate students of how to learn important critical thinking and problem solving skills and share their knowledge in the 21<sup>st</sup> century.*

*Keywords: problem-based learning, PBL support systems, multimedia*

### 1 Introduction

In the 21<sup>st</sup> century up-to-date, promptly adaptable, practical knowledge form the base for successful career, competitive advantage, success and achievements in the life of graduates. Professional knowledge and language competencies are amongst the skills and knowledge that promote career and success in life. The boom and buzz words of the 21<sup>st</sup> century like lifelong learning, promptly adaptable knowledge, self-directed study, multimedia or information society all reflect the significant characteristics of the information society. In the 'learning society' the attitude to learning, the structure and organisation of the learning process have been changing. The teaching-learning process moves from the 'product-based' to 'process-based' learning, and, in parallel, both content and structure of lessons encourage students to engage in active and meaningful learning. The learning environment facilitates such instructional methods that require learners to actively gather and apply knowledge, therefore, takes another shape in which the student's as well as the teacher's roles and duties alter. Consequently, further teaching-learning methods evolve to meet the new requirements of the profession and the demand of the higher education, notwithstanding the challenges of computer-based learning. Practical training and tutor groups as well as work placements get

meaningful and central roles in professional education and training. In order to achieve educational goals and offer active knowledge, the application of problem-based learning (PBL) seems a successful learning tool. Contrary to the traditional learning methods the fundamental principle behind PBL stands in the swap of order of 'lecture → training/seminar' to 'problem → training/tutor group → lecture'.

This paper deals with the application of PBL methods and it outlines its essence. The paper describes the PBL environment and certain activity types applicable in PBL tutor groups. Furthermore, it shows some PBL activities integrated in multimedia solutions and how these activities foster the teaching-learning process. Finally, the paper presents the results of a student satisfaction survey about PBL made among the students on the International Business Economics Course in English at the Budapest Business School Faculty of International Management and Business.

## 2 The Principle of Problem-based Learning

Most of higher educational institutes face the problem how to transfer knowledge and how to develop and ensure professional and up-to-date practical skills. Nowadays, obviously, lifelong learning has proved to be fundamental and the use of multimedia, computer-based teaching-learning as well as e-learning, which, according to Stockley [1] all include 'the use of a computer or electronic device in some way to provide training, educational or learning material'<sup>1</sup> are all cutting a bigger and bigger slice from the cake of education in the information society. At the same time the learners must be trained and prepared to become an independent, autonomous and lifelong learner who, as Oxford [2] claims, is able to plan their 'active, conscious, and purposeful self regulation of learning'<sup>2</sup>. Nevertheless, the undergraduates must be trained and skilled so as to ensure the application of powerful communication and professional skills in their jobs thus helping them to make a career.

As a consequence of the development of industrial society into the information society the teacher-centred learning environment was smoothly replaced by the learner-centred environment, in which the process of learning and not the product is emphasised. Since PBL is a learner-centered instructional method it unambiguously promotes process-oriented learning and numerous other factors that enhance its. Barrows et al. defined PBL as '...the learning which results from the process of working towards the understanding of, or resolution of, a

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<sup>1</sup> <http://derekstockley.com.au/elearning-definition.html>, 23. 04. 2006

<sup>2</sup> Oxford, R. L.: 2003, p. 2

problem'[3]. During the classroom tutorials learners are actively engaged in the learning material, cooperate in the tutor groups and solve authentic, complex, real life problems thus gaining the theoretical knowledge. Boud and Feletti claimed: 'Problem based learning is an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning' [4]. During the process students learn to solve problems, train their communicative skills, will be capable of critical thinking, get prompt feedback and be involved in student self- and peer-assessment. As a result, such skills are fostered that will actively and successfully back them in their future career. As Barrows [5] states the learning process will become 'an active, integrated and constructive process (obviously) influenced by social and contextual factors'<sup>3</sup>. Mayo et al. stated that PBL posed significant, contextualized, authentic situations, and provided students with resources, guidance, and instruction when students developed and applied domain knowledge and problem-solving skills [6]. PBL differentiates to a great extent from the traditional way of teaching that student got familiar to in their primary and secondary education. The principle behind PBL is to change the teaching-learning process and instead of applying the 'theory – practice' (to put theory into practice, e.g. lab or trainings) teaching process, PBL is characterised by the 'problem - practice – theory' learning process. Students get to know the problem first, and after having time to discuss and analyse the problem they actively gather and apply knowledge to solve the problem and find one or multiple solutions. The theoretical learning material will be discussed during the evaluation lecture that follows the tutor groups.

## 2.1 The Learning Environment and Participative Roles

In the student-centered learning environment that is desirable for PBL, the central figure of the learning-teaching process is the student. The learning objective is not the reproduction, recall and learning of passively received learning material but the active and creative engagement of students in group work and in individual study thus transferring the skills and knowledge. The individual, autonomous self-directed learning gives the freedom to the learner to decide individually and consciously on the learning strategy and on the time scale s/he wants to follow. Within PBL students 'identify their learning goals, help plan the seminar, lead discussions'<sup>4</sup> [7], [8] and conduct self- and peer assessment. PBL requires some prior knowledge to start with. Should students know nothing about the given problem or field of profession, the tutor should recognise and give a 'minilecture' before the phases of PBL might start. PBL presumes a conscious way of learning through which the student not only studies the learning material but also actively

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<sup>3</sup> Barrows, H.S.: 1996, p. 5

<sup>4</sup> Reynolds, F.: 1997, p. 269

## A. Tick

### Application of Problem-Based Learning in Classroom Activities and Multimedia

learns it. Students must be aware of their prior knowledge and what they want to learn and what learning strategy they want to apply. As a result, the learning process becomes more interesting, more efficient and the students will become more motivated and self-directed learners. Students will actively participate in the learning process as well as actively take part in order to gain the knowledge (not the teacher 'lectures' the learning material, but the student 'gains' the knowledge). Learning becomes reflective learning that is the students with the help of the tutor discuss the theory through the problem during the evaluation lecture that follows the seminar or as it can be called the tutor group. The theoretical part of the learning material is covered during these evaluation lectures.

## 2.2 The Structure of the Lesson

The structure of the lesson, the students' roles and their activity, as well as the teacher's role significantly differs from the conventional roles in the traditional teaching-learning environment. Moust, Bouhuijs és Schmidt [9] determined the phases of a PBL lesson in seven steps. The tutorials practically are split into two, since the evaluation and assessment of a problem is conducted in the following tutorial. The table below presents these seven steps:

Steps	Activities in and outside the tutorial
<b>1 Clarify terms and concepts that are not clear</b>	Clear away unnecessary obstacles such as terms and concepts that are unknown or not understood.
<b>2 Define the problem</b>	Clarify the problem that is to be solved by formulating one or more questions.
<b>3 Analyse the problem</b>	Give possible explanations base on prior knowledge. No discussion: brainstorming. Give as many different explanations as possible on the basis of prior knowledge, practical experience or your own ideas.
<b>4 Discussion</b>	Discuss the possible explanations of step 3. Make the connection between them clear. What knowledge is lacking?
<b>5 Formulate learning goals</b>	On the basis of the results of step 4, formulate learning assignments in the form of questions that have to be answered.
<b>6 Self study</b>	Look for literature and sources of information to gain knowledge and understanding of the subjects that are formulated in the learning goals. First, study the theoretical concepts, than apply these to the problem afterwards.
<b>7 Evaluation</b>	The agenda of the evaluation is determined by the learning goals formulated in the previous step. Take stock of the used sources of information. Discuss the theories and explanations that were found for the problem. Formulate in your own words (do not read out!). Have the learning goals been reached?

Figure 1

Seven phases of PBL by Moust, Bouhuijs és Schmidt [9]

### 2.3 Student Roles

In a PBL tutorial the roles of the student also turns from passive to active. Contrary to the conventional lesson, ‘surviving’ the lesson is not a possible alternative or behaviour, only active contribution to the discussion counts. A student can play three main roles in a tutorial – roles taken in a discussion or in group dynamics are not listed -: chair person, assistant and group member [9]. The tasks related to the various roles are summarised in the following table.

Roles	Tasks
<b>Chairperson</b>	<ul style="list-style-type: none"><li>• Structures the tutor groups and chairs the discussion</li><li>• Monitors progress and time</li><li>• Summarises the outcome of every step</li><li>• Encourages active participation of the group members</li><li>• Contributes actively himself</li></ul>
<b>Assistant</b>	<ul style="list-style-type: none"><li>• Puts the remarks made during step 1 to 5 and 7 on the blackboard in such a way that it is visible for everyone</li><li>• Provides structure</li><li>• Participates actively in the discussion</li></ul>
<b>Group member</b>	<ul style="list-style-type: none"><li>• Contributes actively to the discussion</li><li>• Makes notes and writes down matters that are relevant for him</li></ul>

Figure 2  
Student roles based on Moust, Bouhuijs and Schmidt

As the fundamental criterion of group- and teamwork requires, students actively participate in the work with their creative thinking and ideas, as well as they gather information to the problem in their individual self study time. Furthermore, students must learn the theory or the gathered information in order to enable them to recall it and to apply it actively in the following tutorial. Without all this PBL will fail to succeed.

### 2.4 Roles of the Teacher

Similarly to the changed student roles, the roles of the teacher also change compared to the roles in the traditional teaching-learning environment. The teacher becomes a tutor and a facilitator, whose role is to create such a learning environment in which students feel comfortable and are encouraged to form their ideas freely. In this learning environment mistakes are considered as possible learning opportunities and not indicators of serious lack of knowledge. Tutors, of course, still have professional knowledge and should the discussion go sideways, the tutor has to intervene by asking questions and send the discussion back to the right direction. If problem-solving is stuck at some point in the tutor group, the teacher again intervenes with his/her questions in order to ‘roll the ball’ The tutor must ‘find the appropriate balance between allowing students to discuss issues on

their own and intervening in group interactions<sup>5</sup> [11]. The tutor's responsibility is to stimulate the learning process, to encourage active cooperation within student groups, and to monitor and assess the depth and complexity of the discussion, the learning process, and the achievement of the learning goals. The teacher is not an instructor, but a cognitive trainer, a coach who helps students become independent, self-directed learners, who are capable of creative thinking therefore ensuring more successful training. Consequently, PBL becomes again more efficient and makes student more motivated in the learning process. At the same time, the tutor should also develop classroom-and group-work norms, and the attendance policy and give due dates and prescribe course fulfilment criteria.

### 3 Types of Problems in PBL Tutorials

PBL has successfully been being applied in several fields of profession since the 70s. PBL has proved to be successful in medical studies, in electronic engineering as well as in economics education, since real life problems occur in each discipline, these types of problems must be solved after graduation. If we restrict our examination into higher education in foreign languages or in ESP (English for Specific Purposes) it can be noted that these are content-based, process-oriented educational forms, where language becomes a tool. In the fields of ESP it is inevitable that the teacher/tutor should be familiar with the profession thus resulting in a content-based educational form, where PBL can be applied.

There are four-five types of problems that can be applied in PBL courses. These are **case studies**, **simulations**, **role-plays**, so-called '**ill-structured**' i.e. problems with multiple solutions and **task-based** or **project-based** problems. These types can all be solved in group- and team- work or in workgroups. Self study is carried out outside the tutorial as the form of autonomous, individual study. Workgroups and/or group-work are the basic learning structures in PBL. They help to create smaller learner- and working communities, to learn and work in these communities and help students take on their ideas and arguments. A more liberal, looser group dynamics make it possible for the students to learn such communication skills like right questioning, brainstorming or arguing. They learn to actively participate in the work process, since a PBL course always closes with self- and peer- assessment. If the student is confident and feels that his/her opinion and work is important for the group s/he will definitely become more motivated and his/her learning efficiency grow.

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<sup>5</sup> Gijselsers, W.H.: 1997, p. 16

### 3.1 Case Studies

The application of **case studies** in the traditional learning environment has already required an active participation in the learning process. However, case studies can be solved individually and do not require group discussions outside the classroom. Case studies can be not only tailor-made, simplified case studies, but case studies taken from journals, annual report, or periodicals as well. The tutor's task is to select such problems, debates or studies taken from real life cases that make the tutorial up-to-date, more interesting and attractive.

### 3.2 Simulations

The merger of **simulations** and problem-based learning (PBL) can enhance both active-learning strategies, on condition that adequate software is available. Simulations benefit by using a PBL framework to promote student-directed learning and problem-solving skills to explain a simulated dilemma with multiple solutions. Further brainstorming and a discussion of possible other solutions can be made outside the classroom. The practical usage of simulation games can be seen during work placements which enable students to try out solutions found in simulations in real life circumstances. PBL benefits because simulations structure the information students receive to focus learning on the intended curriculum and increase the strategy's effectiveness in a wider variety of venues. A combined strategy - a PBL simulation - places its simulation at the forefront of learning and helps students and teachers sift through the overwhelming complexity that can arise in a more pure PBL [10].

### 3.3 Role-Plays

In **role plays** students are guided to a certain role within the framework of a given multimedia education software, in which they have to make strategic decisions and must undertake the positive and negative consequences of the decisions. Role plays can also be conducted in classroom frame, however, it loses its content of reality.

### 3.4 Multiple Solution Problems

**Multiple solution problems** face students to so-called 'ill structured' problems with no single or 'right' solution, where students must look at many methods to decide on the ideal solution of these open-ended and complex problems [7]. These problems encourage most the students to actively participate in the debate and at the same time help them to gather experience in decision making. Creativity, flexibility and motivation are such skills that are improved to a great extend while

## A. Tick

### Application of Problem-Based Learning in Classroom Activities and Multimedia

these problems help most to learn the ideas, concepts and techniques. The learning goal of these problems is to emphasise the adequate depth of knowledge and not the breadth of content covered. There is no unique solution, but solution alternatives must be presented in case of these open-ended, complex problems. It is not enough for students to recall the already learnt material but it has to be actively used in order to enable students to support their own version of solution and/or to give valid criticism and argumentation to others' solutions.

## 3.5 Task-based Problems

**Task-based problems** include smaller problems like newspaper articles, photo, charts, dialogue, citation or interview, furthermore discussion tasks, strategy tasks, assignments and other application tasks [9]. The biggest difference between problem solving and debates is that while, on the one hand, the central element of problem solving is to find the right solution or explanation for a problem, 'discussions', on the other hand, 'are introduced into the course to help students adopt a more critical stance towards their subjects'<sup>6</sup> and to teach arguing and counter arguing. During these discussion students get familiar with negotiation skills and learn more precise arguing techniques. These discussion will prepare student for 'their professional life where [they] will be required to conduct debates and express [their] opinions articulately'<sup>7</sup>. The aim of the strategy tasks is to teach how to make rational judgements on the basis of well-grounded and valid knowledge. In the decision making process students are required to underlie and support each of their decision making steps. Good argumentation is half success on professional life. The formulation of the steps needed for solving a certain strategy task is emphasised. In assignments students are invited to study individually and do research in the library or at home. The sources for research and study material are explicitly specified. The presentation of an assignment might give platform for further discussions and a new problem. Application tasks aim to help students put theory into practice. These tasks might range from statistics to law related tasks.

## 3.6 Project-based Learning

As a strategic step in PBL an advanced phase of **project-based learning** can be integrated or can take over problem-based learning. In this phase the student is capable of individual problem solving, applying theory in practical tasks and pursue critical and creative thinking. Projects can be implemented in PBL courses, i.e. teams must prepare a larger project autonomously by the end of the course,

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<sup>6</sup> Moust, J. H. C., Bouhuijs, P. A. J., Schmidt, H. G.: 2001, p. 41

<sup>7</sup> Moust, J. H. C., Bouhuijs, P. A. J., Schmidt, H. G.: 2001, p. 41

and/or a week can be dedicated as a project week, and the teams have to finish the project by due date.

### **3.7 PBL-Support Systems**

Taking the technological possibilities into account, multimedia and network-based solutions in the virtual learning environment can further enhance the above activity types. Since the virtual classroom offers similar services as a conventional classroom [13] like interactive and programmed learning, assignment submissions or consultations, PBL solutions are also offered via the web. There are numerous computer-based solutions and software products that support problem-based learning. The advantage of these programmes is that asynchronous learning can be realised and students add as much information to the topic in questions as they found useful. After brainstorming and gathering of ideas on a virtual platform, these will be recorded and on the next occasion the starting point will be the end point of the previous session. No ideas will be lost, while unnecessary and redundant data can be deleted. Only the relevant information will be available for the students at the solution of the problem. There are several computerised PBL support systems such as document-based systems like CSILE, CALE, CNB, McBAGEL and Web-SMILE or conferencing-based systems like CCL and Belvedere and CROCODILE. In these systems the collaborative PBL activity is mainly mediated by the shared information spaces. Some systems such as CSILE and Belvedere support communication by providing a chatboard that is used separately from the shared information spaces, however, they do not address the problems of social orientation, group awareness, and customizing learning contexts. By examining the drawbacks of the above PBL support systems CROCODILE (Creative Open Cooperative Distributed Learning Environment) [14] has been developed to fill the market niche. It strives to realise such features like supporting social orientation, group awareness, customization of learning environments, synchronization of collaborative activities, support shifting between PBL strategies and execution of action plans that are all missing from the other PBL support systems. The examination and evaluation of these PBL support systems, however, is the task of some future research.

## **4 Evaluation of Problem-based Learning**

One of the corner points of the application of problem-based methods is evaluation and assessment. There are three different types of assessment: self assessment, peer assessment and tutor's assessment [12]. Furthermore, the course and the problem based learning itself can be assessed. Eighty percent of the courses on the International Business Economics course in English at the Faculty

## A. Tick

### Application of Problem-Based Learning in Classroom Activities and Multimedia

of International Management and Business of the Budapest Business School are taught in English. I have investigated about 60 students mainly on the fifth and seventh semester of their studies how they evaluate PBL, what they have learnt from it and to what extent they have found this method 'better' than the traditional educational form. See the survey results below.

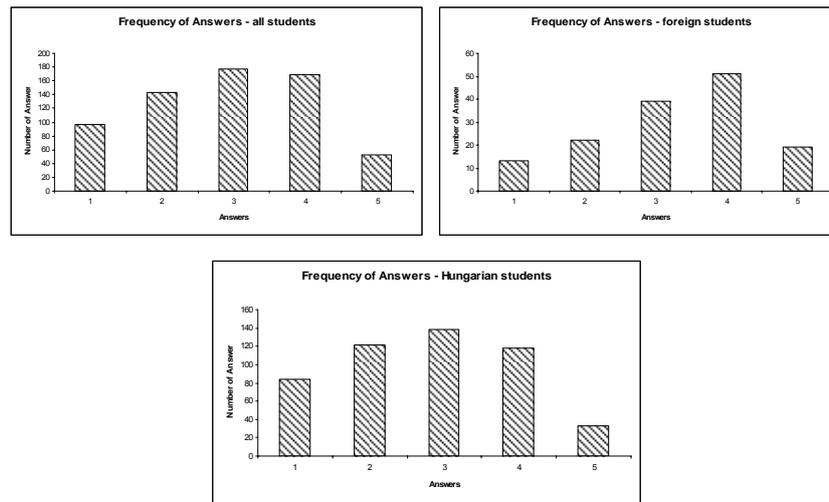


Figure 3

Frequency of answers in case of all the students, foreign students and Hungarian students

Upon evaluating the questionnaire neither the overwhelming success nor the failure of PBL can be concluded. Evaluating the questions one by one it can be noted that the students find PBL courses interesting (3,27), they discuss up-to-date, real-life and relevant problems with pleasure, and are able to link the theoretical knowledge to the problem. (3,8). Majority of the students prefer teamwork and feel that they have learnt quite a lot from each other (3,08). Regarding self-directed study, it would be advisable for students to work, do some research and carry out self study in groups outside the classroom. It is quite promising that two thirds of the students believe that they have studied as much (3,23) as they could have done in a conventionally structured course and they think they have learnt as thoroughly with PBL as they would have done on a traditional course (3,06). Bearing in mind that the students have got used to the conventional way of teaching throughout their earlier studies, the 3.23 result can be considered a success. The average 2.97, however, which refers to the statement that students would have understood the theory better in a conventional lecture-seminar form, contradicts a bit to the previous result. In my opinion, the reason behind the above is that students did not really enjoy the courses (2.97), furthermore, the role of teacher/tutor comes to the forefront, since it is the tutor's role to create such a good atmosphere and build the group dynamics, in which

students are not frustrated and have the courage to open up and give his/her opinion. For the question referring to the study time three-quarters of students think that they had to spend more time on studying and preparing for exams.

However, this – self-directed research and study – is one of the crucial points of PBL. The teacher/tutor/facilitator will always be available for face-to-face consultation either individually or in group forms. Evaluating the questionnaire by separating the Hungarian and foreign students it can be noted that PBL are more popular and acknowledged amongst foreign students (primarily students on the Erasmus exchange programme from western countries) than among Hungarians. Reasons might root in the differences in the educational structure and the culture of the countries. In order to make PBL more successful and more efficient not only the students but the teachers must be prepared and trained as well. In my opinion, the slightly worse ‘Hungarian’ results reflect teacher resistance and reluctance to PBL, since Hungarian teachers have also socialised in the conventional educational structure and way of teaching. First the teacher ought to be prepared for the application of a new method and their commitment might bring the smashing success of problem-based learning.

### **Conclusions**

Both the challenges of the 21<sup>st</sup> century and the requirements of the professions force higher educational institutes to integrate the training of problem solving skills, team work and decision making in their curriculum. PBL has proved to be a successful tool to a great extent, since it is capable of converting the passively gained knowledge into an active one. The types of activities using PBL help to create and train such skills like efficient communication skills, good presentation skills, good meeting skills and at the same time prepare for teamwork. Furthermore, this way of learning also prepares students for individual, life long learning.

This paper has examined some potential activity types that can be integrated in PBL courses, some PBL support systems, some pitfalls and has presented the result of a survey on PBL made among the students studying on the dual awards programme in English at BBS FIMB. Two statements can be made as a result of the survey at the Faculty of International Business and Management of the Budapest Business School. On the one hand, the students, who are used to the traditional ‘giving lecture-learn-report/recall’ way of learning after their elementary and secondary studies, are open to the PBL, however, foreign students are more skilled for opinion forming and/or self-directed study. On the other hand, when examining the teacher/tutor side, the question whether the teachers are prepared and trained for PBL has arisen. Are they really trained for the facilitator-tutor role? There have been feedbacks from various courses saying that the teacher does not do anything, and/or the students are left alone. As a next step, I would like to investigate teachers’ attitude to and readiness for the PBL.

In summary, it can be argued that with the application of PBL in various courses the students have become more confident, more self-secured students with more practical knowledge, who can stand by their opinions and gain such valuable skills that will enhance learning motivation and efficiency and as a result the ability to achieve and succeed in the market [15].

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