Possibilities of using Problem Based Learning when Teaching IT Specialists at Russian Universities (Example of Saratov State University)

R. Amelin[1], L.B. Kofoed[2] and L. Bessonov[3]

[1] Department of mechanics & mathematics, Saratov State University, Russian Federation. ame-roman@yandex.ru
[2] Department of Architecture, Design & Media Technology, Aalborg University, Denmark. lk@create.aau.dk
[3] Department of mechanics & mathematics, Saratov State University, Russian Federation. lexx.besson@gmail.com

Abstract

Problem Based Learning (PBL) is a perspective modern approach to education. Aalborg University experience demonstrates the effectiveness of the approach in training of modern specialists who "concentrate on the solution of problems in a counterbalance to the solution of tasks". Important principles of this educational paradigm are:1) Theme of semester; 2) Continuous group work during the semester; 3) Students manage their own educational processes; 4) The teacher and group members as resources. Russian educational system has restrictions to use PBL. Some of them are: 1) "Vertical" structure of learning plans. Related courses follow each other in different semesters. So there is no theme of semester; 2) The classroom set-up has limitations. There is no way to provide a permanent place for a project work for each group; 3) Classical forms of education are based on an active role of the teacher; 4. While evaluating students it is supposed that they have received an identical set of knowledge and skills listed at federal education standards – and this set is evaluated. The individual educational trajectory of the student practically is not considered. The best way of adapting PBL within Russian educational system is to do it within the additional educational program. It is an educational program which students can join in addition to the main program. Classes are given in parallel with the main ones. When finishing the student receives the certificate on assignment of the additional qualification, being the annex to the main diploma. The experiment was started in Saratov State University in September 2013 with 3rd year students of additional educational program «Web designer». The experimental results will be used in developing bachelors programs using PBL.

Keywords: *Problem Based Learning, Russian educational System, Additional educational program, IT education.*

1. Introduction

One of the key problems of teaching at higher schools is students' lack of motivation.

The Soviet educational system was based on a planned economy and used a paradigm of centralized defined employment of graduates: each student was going to take a position planned in advance which was defined by the state in general mechanism. The state decided what each expert had to know and would be able to do, and this was supported by means of higher educational institutions which pursued this planned policy. Students played a passive role in this system [1]. The remains of the former Soviet mentality in modern Russian society generate a serious motivation problem. Many students expect only to meet formal requirements of the system that consist in receiving a positive assessment of what they have to learn, though they live in a globalized society and have to compete on a global labor market. Meanwhile, modern IT specialist is expected to be proactive, be able for continuous learning, and be even better to know and use and develop new technologies than his/her senior colleagues and teachers.

One of the central tasks of modern Russian universities is a search for a new pedagogical approach which can be adapted to the classical educational system, and which can motivate students to proactive teaching and learning. In this paper we consider the experience from Aalborg University (Denmark) where Problem Based Learning (PBL) is used.

2. PBL experience from Aalborg University

PBL is used at Aalborg University as the main pedagogical approach and has been used from its foundation in 1974.

The essence of PBL is that students concentrate on the solution of problems in a counterbalance to the solution of tasks [2]. Students find or receive an applied problem from the real world and try to solve it, using the knowledge needed and received in the academic courses. As it is noted, "PBL allows to acquire a material through understanding of real life situations that provides full development of a material by students by means of collecting and studying necessary (individual for everyone) information and creates possibilities of development of skills of activity and adoption of concrete decisions in team" [3].

An important factor from the problem-oriented approach is the project based organization of the learning process. Students break into some small groups, which during a semester work on a project focused on the solution of a chosen problem. Teachers participate in a role of supervisors. They do not teach in a traditional way, they are more seen as facilitators or coachers for students' project process.

The main idea of this pedagogical approach is the *project*. It has the following specific characteristics of the process of teaching and learning:

1. Each semester has a *theme*. Within this theme *problems* are formulated. These problems are solved by means of student's projects. Courses which are given during a semester are also connected by this subject. Thus, students receive the basic knowledge necessary (but not always enough) for developing and implementation of the project. Projects are mostly interdisciplinary because they are based on real problems which normally are very complex of nature.

2. The project is carried out by a group of students. Each group has a work space available during the semester. Students can gather and work on their project at any time when they have no courses to attend.

3. From the first semester students study management of projects, time-management, work in team, conflict management, communication, etc [4]. It allows students to manage their own learning process. For example, at the initial stage of work students develop the time-plan of the project and define the deadlines. And there are fixed deadlines e.g. for mid-time presentation and for finalizing the project.

4. The teacher acts as supervisor and consultant, and normally they do only interfere when asked by the students to do so. Students use the supervisors as a resource. The supervisor support the learning process, answers or discuss questions, gives advice, help finding literature and choosing it-components and programs. A very important part of supervision is to get students to reflect their learning and guide them to learn more by using both theories and practical lab work. The result is evaluated either internal by other teachers or external by teachers from other universities or representatives from industry.

The motivating force of this approach consists of project work where students bring theories into a real problem solving process by finding relevant theories and data to choose the best solutions to their chosen problem. Another motivational factor is that, students start perceiving the project as "their own", they take ownership, and find the project process challenging and rewarding. The learning take place in individual level, but the social aspects of learning seems to add very much to the motivational active learning process e.g. during discussions about elements in their project. Furthermore during the problem solving process student want to get more knowledge "to make the good project, I have to know more". Through motivation it leads to increase in efficiency of the educational process.

PBL is universal. It can be used in different spheres. But the greatest effect PBL has e.g. when training IT- or other technical specialists because development of student's projects models are reflecting the real work of developers of all technical systems. This effect is showed by Aalborg University in teaching of the interdisciplinary Medialogy program [5].

3. Russian Educational System: main characteristics

Characteristic feature of Russian educational system is regulation by the government. The government approves the educational standards ordering structure of curricula, names of subject matters and their frame contents. Within these standards universities can only define structure of special disciplines (about 15% from all educational programs). According to Russia's involving in Bologna Process, the situation is changing towards bigger flexibility. However, the nomenclature of training programs and about 50% of their contents are still regulated by the state educational standards.

Characteristics of the organization of educational process in Russia is also a large number of disciplines/courses (about 10-15 in each semester), the schedule organization is in "classes" (each discipline is given in one and a half or three hours during the day, and every day students have 3-4 disciplines on average), vertical integration of courses (the interconnected courses are given usually consistently in different semester).

For example, in table 1 one week of a student of Saratov State University (SSU), specialty "Applied Informatics in Economy", is presented.

Table 1. SSU Student's week

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
08:20-09:50		Theory of Systems and System Analysis (lecture)				
10:00-11:35		Imitating Modeling of Economic Processes (practice)		Management (practice)	World Information Resources (lecture)	Network economy (lecture)
12:05-13:40	Health and Safety (lecture)	Imitating Modeling of Economic Processes (lecture)	Databases (lecture)	Management (lecture)	World Information Resources (practice)	Political Science (lecture)
13:50-15:25	Network economy (practice)		Databases (practice)	Physical Culture	Special Seminar I	
15:35-17:10	Physical Culture					
17:20-18:40			Development of Websites and Applications (practice)	Development of Websites and Applications (lecture)		

4. How we can adapt PBL to Russian Educational System?

4.1. Scales of Educational Program

Features of Russian educational system cause the following difficulties at adaptation of project-oriented approach in the framework of educational program (bachelor or master):

1. Courses in one semester have no connections with each other. It is hard to define a semester theme. In curricula courses are connected consistently (the connected courses are in different semester). In table 2 the sequence of the interconnected courses of an additional educational program "Web-designer" is represented (look the block "Web Design and Programming" for example).

Table 2. Curricula of additional educational program "Web-designer"

Semester	Courses		
	Web Design and Programming	Instrumental	Subject Areas
1	Introduction to Web Technology	Introduction of Specialty	Theory of Composition

2	Hypertext Markup	Polygraph and Text Design	and Color Science
3	Requirements Analysis and Design of Web-sites and Applications	Raster Graphics	Modern Design and Computer Graphics
4	Web-Development I (Databases and Server Programming)		Special Course #1 (Advertising)
5	Web-Development II (Client Programming)	Vector Graphics	Special Course #2 (Games)
6	Web-Development II (Group Projects)	3D Graphics	Special Course #3 (Design of User Interface)
7	OS and Networks		Special Course #4 (Interior Design)
8	Maintenance of Web-sites and Applications	Animation	Special Course #5

2. The classroom set-up has limitations. There is no way to provide a permanent place for project work for each group.

3. Classical forms of education are based on an active role of the teacher. The teacher will organize the educational process in time, defines what results when and in what sequence results have to be reached. The teacher decides which knowledge and in what form should be given to students. Students are passive learners during the courses. PBL introduction into Russian universities might be difficult both for students and teachers. Students see the teacher as the main source of information and often they are not interested in something outside the knowledge offered to them; teachers often have no skills of supervising or consulting students learning process. [6].

4. While evaluating students it is supposed that they have received an identical set of knowledge and skills listed in federal educational standards and this set is evaluated. The individual educational trajectory of the student practically is not considered.

So, it might be difficult to start a change process among teachers used to another system and to overcome psychological barriers of the participants in the educational process. Furthermore it might be difficult to develop innovative curricula which could fit into existing state standards of education.

4.2. Scales of One Separately Taken Course

An alternative to introduction of PBL within the program of preparation of bachelors/masters could be to use it within separately taken courses. This method was repeatedly used in Russian higher educational institutions [7].

Key advantage of PBL for Saratov State University is interdisciplinarity. In the framework of one course it has no effect.

4.3. Scales of Additional Educational Program

An additional educational program is a program which students can join in addition to the main program, and for concrete additional qualification the set of admissible basic programs is given. Classes are given in parallel with the main (in fact, the additional program expands the list of the disciplines taught during a semester and increases the number of everyday classes for students). When finishing the course each student receives certificate on assignment of the additional qualification, being the annex to the main diploma.

For example, since 2003 in SSU the additional educational program "Web designer" has been taught. Standards and curricula of this program are defined by the university. In the framework of this program experts in the field of information design are trained. Additional educational program unites have three blocks of disciplines:

1) General courses connected with design (the color theory, the composition theory, design history, etc.) and subject domains of application of information design (polygraphy, advertising, interior design, computer games, etc.)

2) Subjects connected with training in design tools, independent of concrete subject domain (raster graphics, vector graphics, 3D, etc.)

3) Courses connected with development of websites [8].

Approbation of complete PBL by training students who are a part of additional educational is seemed to be the most perspective.

Conclusions and Perspectives

Additional educational program uses classical approach for Russian educational system. The curriculum is constructed by the "vertical" principle: in each semester three disciplines, one of each group are taught. However, additional qualification is not regulated by state standards and the university is more flexible in choice of forms and training techniques. Therefore, at this level effective approbation of PBL can be carried out. For this purpose it is necessary:

1. To create "horizontal integration" of courses, having chosen a theme for each semester. Some of these themes will require rearranging in the current program. One of possible options is presented in table 3.

Table 3. Possible changes in curricula

Semester 2. Theme: Polygraphy Production		
Polygraphy and Text Design	Raster Graphics	Vector graphics
Semester 3. Theme: Prototyping of Web-sites and Applications		
Requirements Analysis and Design of Web-sites and Applications	Hypertext Markup	Special Course #3 (Design of User Interface)
Semester 6. Theme: 3D-production		
3D graphics	Special Course #2 (Games)	Special Course #4 (Interior Design)

2. On the basis of these themes and supporting courses there might be small students groups (5-7 people), semester projects under supervision of curators (not necessarily lectors). Work form – independent meetings of students with weekly consultation of their curator. Exam form – project presentation within commission of teachers.

3. To include a course of project management in introduction disciplines of the first semester.

4. It might be important to establish good information for all teachers. For involved teachers there should be a PBL workshop, to give a good understanding of how to use PBL.

First experiment was started in Saratov State University in September 2013 with 3rd year students of additional educational program «Web designer». Currently, the following results have been achieved:

1. Increase of student motivation

2. Improving the quality of student projects

3. Development of teamwork skills, time management, proactive interaction with the teacher.

PBL can be adapted to additional educational program most completely and effectively, because of the flexibility of curricula. After studying the results of the experiment experience of such approbation can then be extended to bachelor profiles ("Applied informatics in computer design" and "Media Technologies").

References

[1] Растопшин И. А. “Уроки реформирования высшей школы во второй половине XX века”, *Высшее образование для XXI века*, Москва, 2007.

[2] Nordahl, R and Busk Kofoed, L. “Learning Lab – Teaching Experienced Engineering Students PBL,” *Proceedings of the 18th Conference of the Australasian Association for Engineering Education*, Melbourne, 2007.

[3] Искренко Э. В., Полтон Т. А. “Проблемно-ориентированное обучение: особенности методики преподавания в Великобритании (на примере St. George University of London, Great Britain)”, Научные ведомости БелГУ. Серия: История. Политология. Экономика. Информатика, №8, 2008.

[4] Busk Kofoed, L. “Introduction an Innovative Project Management Framework for First Year Students – Project Work in a PBL Environment,” *International Conference on Engineering Educatio*n, ICEE-2010, Gliwice, 2010.

[5] Nordahl, R and Busk Kofoed, L. “Medialogy – an Interdisciplinary Education Challenge In a Problem Based Learning Environment,” *Proceedings of the 8th International CDIO Conference*, Queensland University of Technology, Brisbane, 2012.

[6] Шухов В. С., Володин Н. Н., Чучалин А. Г., Гуэрра Р.. “Вопросы непрерывного медицинского образования (проблемно-ориентированное обучение)”, Лечащий врач, № 3, 2000.

[7] Чернов И. П., Ларионов В. В. “Инновационное проблемно (проектно)-ориентированное обучение физике в лабораторном практикуме по механике в технических университетах”, Инженерное образование, № 3, 2005.

[8] Амелин Р. В., Кулёмина Ю. В. “Специфика подготовки бакалавров по профилю «Прикладная информатика в компьютерном дизайне» в Саратовском государственном университете”, *Новые образовательные стандарты высшей школы: традиции и инновации*, Саратов, 2012, с. 159-161.