



# New Trends and Issues Proceedings on Humanities and Social Sciences



Issue 5 (2017) 19-25

ISSN:2421-8030

[www.prosoc.eu](http://www.prosoc.eu)

Selected paper of 5th International Conference on Education- IC-ED-2016, 26-28 May 2016, South East European University, Skopje Campus.

## IT instruments for Problem Based Learning in Undergraduate Medical Education

**Tudor Calinici**<sup>a\*</sup>, University of Medicine and Pharmacy Cluj-Napoca, Romania

**Florina Nistor**<sup>b</sup>, University of Medicine and Pharmacy Cluj-Napoca, Romania

**Dan Istrate**<sup>c</sup>, University of Medicine and Pharmacy Cluj-Napoca, Romania

**Tudor Drugan**<sup>d</sup>, University of Medicine and Pharmacy Cluj-Napoca, Romania

### Suggested Citation:

Calinici, T., Nistor, F., Istrate, D. & Drugan, T. (2016). IT instruments for Problem Based Learning in Undergraduate Medical Education. *New Trends and Issues Proceedings on Humanities and Social Sciences*. [Online]. 05, pp 19-25. Available from: [www.prosoc.eu](http://www.prosoc.eu)

Selection and peer review under responsibility of Prof. Dr. Milan Matijević, *University of Zagreb, Croatia*  
©2017 SciencePark Research, Organization & Counseling. All rights reserved.

---

### Abstract

Problem Based Learning (PBL) is one of the many alternative methods that can be used in medical education. There are different views about its advantages and limitations, but the added value of this method is well recognized. PBL helps students develop team working and collaboration. It is useful to have an IT solution to support the PBL process. The goal of this research was to identify a web application which would implement the facilities necessary for Problem Based Learning at the curriculum level; secure, providing a collaborative environment, availability and easy to use. A PBL scenario was developed and a demo for Problem Base Learning session was conducted. The participants were students enrolled in first year at Faculty of Medicine, and the Problem Based Learning topic was biostatistics. We use Moodle as IT support for Problem Based Learning process. A Problem Based Learning session took place and it was a success. The students had no problem using the on-line interface and the general conclusion was that Moodle is a viable option to be used as support for PBL sessions. Moodle seems to be an appropriate Web 2.0 instrument to be used as support for Problem Based Learning. It is very important to recognize that Moodle is just a tool which facilitates learning but not a guarantee of the success. The success of the Problem Based Learning method in medical education is in the involvement of the students, in the skills of the facilitator and in the quality of the clinical scenario.

Keywords: problem based learning; e-learning; Moodle

---

\*ADDRESS FOR CORRESPONDENCE: **Tudor Calinici**, University of Medicine and Pharmacy Cluj-Napoca, Romania.  
E-Mail Address: [tcalinici@umfcluj.ro](mailto:tcalinici@umfcluj.ro) / Tel.: +40 264 597 256

## 1. Introduction

Problem based learning (PBL) is an educational method in which the learning takes place by solving specific problems, using both interaction and individual study, and supervised by a teacher – called a facilitator. In medical area, a PBL session will start from a real-life situation, most of the time a clinical scenario, which is read and, under the supervision of the facilitator, the students identify the unknown topics that must be understood and learned. After that, the students have a period of time for individual study. The group rejoins and applying the new learned knowledge, the problem is solved (Munteanu & Rednic, 2005). PBL was used for the first time in medical education in the late 60s, at McMaster University in Canada. The reason for implementing this new method was the statement that the process for diagnosing a patient is based by a combination of clinical reasoning and specific knowledge in different domains. By learning specific disciplines (anatomy, physiology, neurology, pharmacology) as individual ones, the students fail to integrate the knowledge in clinical context and have difficulties in applying in the practice. The advance of the medical science and the rapid changing of the specific approaches were also an argument for the use of the PBL as educational method in medical education (Graaf & Kolmos, 2007; Barrows, 1980). The validity of this method in medical education was studied by Albanese and Mitchell in a meta-analysis which contains 20 studies evaluating PBL results (Albanese & Mitchell, 1993). The conclusion was that there was no significant difference between the results of the conventional tests (e.g. national examinations) between the students who were prepared through PBL and the students who employed the traditional way, but the PBL students were better on clinical abilities. Another study carried by Denton, Adamas, Blatt & Lorish, (2000) reported the same results as well as the preference of the students for PBL.

PBL is a student-centered method, so the students have to find out by themselves what must be learned; they have to process the information and activate the previous knowledge. In this way they will learn only the things that they consider to be essential in their own style and pace. This thing motivates the students, and it is easier for them to learn, because they are the ones who establish both the learning objectives and the way in which those must be achieved. Another strong point of this method is that the students will gain the ability not only to identify what they have to learn but to find the relevant bibliography. So, it is very important that the facilitator does not provide the students the bibliographical resources, only to guide them in identifying the topics that must be learned. The success of the method stays in the students' wish to develop themselves both professionally and personally. Starting from the problem, the students will learn not only more information about the subject, but also how to learn and where to find relevant information (Munteanu & Rednic, 2005; Barrows, 1980).

The main principles of PBL are open answer questions and study in group. The problems are the learning vehicles and the group is their fuel (Duch, Groh & Allen, 2001). The problems used in PBL sessions must be written in such way so the solution is not evident. To stimulate self-motivation, the problems must be realistic and the scenarios must be in resonance with the students' experience. The solutions must be complex enough, they must include more interconnected parts and all the process must motivate the students to feel the need for knowledge and learning. When the students launch hypotheses in front of the group, they publicly expose their level of knowledge and they are preparing themselves for future learning. Good problems need multidisciplinary approaches and help to develop the communication abilities (Hmelo-Silver, 2004). The students must identify the key concepts to find resources and to collaborate. When the students learn and understand a topic, they automatically apply this knowledge to find the solution for the problem. They must explain it to the others, so the learning becomes active. Doing that, the students develop social and cognitive abilities, assume responsibilities and gain new knowledge.

The second main principle of PBL is the group study. The students examine the problem together, coordinate their efforts, cooperate for a collective scope and collaborate for summarizing and presenting the conclusions (Torre, Van Der Vleuten & Dolmans, 2015). Students work in small groups – 4-8 people, guided by a facilitator. To reach the maximum efficacy, the group needs 3 to 5 sessions together. Different members of the group will have, from time to time, different roles – the coordinator of the discussion, the writer, the reader of the case etc. There are situations where the problem is presented to the group as a

written scenario, which must be read in order, but at the same time, by all the group members (Munteanu & Rednic, 2005)

The implementation of PBL in medical education was done after a detailed analysis of the way in which the doctors react in front of a patient. Barrows (Barrows, 1986) divides the clinical reasoning in the following steps:

- Receiving and interpreting the information
- Generating hypotheses
- Research strategy and clinical abilities
- Formulating the problem
- Diagnose and/or therapeutically approach (conclusion)

These steps of clinical thinking occur very fast in the mind of the practitioners so their presence at many times is unnoticed. PBL allows the identification of these steps and the students gain the ability to properly approach them (Barrows, 1980). Based on this, there are many implementations of PBL method on different medical universities, the most common one being the 7 steps Maastricht method (Davis, 1999):

1. Identifying and clarifying the unknown terms from the clinical scenario – a student writes all the unexplained terms.
2. Defining the problem or the problems which must be discussed – students may have different opinions about this, all the opinions must be taken into consideration, a student writes a list of the problems
3. A brainstorming session to discuss the problems, to suggest the solutions – the students are using their previous knowledge in order to identify what knowledge is missing – a student will record the discussion
4. Reviewing steps 2 and 3 – organizing the notes.
5. Formulation of the learning objectives – the group reaches consensus for learning objectives, the facilitator ensures that the learning objectives are appropriate, reachable and comprehensive.
6. Individual study – all the students gain information about the topics.
7. The group share the information – the students solve the problem, the facilitator is able to verify if the learning objectives are reached and also can asses the students.

The role of the facilitator is critical in PBL. The facilitator is responsible for moving between the steps and for the monitoring of the group and its dynamic. This is important, because during PBL sessions, all the students must join the discussion, share opinions and discuss other ideas (Hmelo-Silver, 2004). The way in which the students are assessed determines how the students learn. If the assessing is based on the capability of the students to memorize facts and information, with a big probability, the PBL implementation will fail. The evaluation must be appropriate with the PBL principles. The evaluation must be made during the group activity. The feedback of the facilitator is essential. The group must be encouraged to reflect on their performance, both as individuals and as group. The evaluation at the group level (all the students receive the same grade) encourage the students to reach the PBL objectives (Wood, 2003). Another important component of the evaluation is receiving feedback from the other peers in group. This means the ability for listening and speaking, the quality of information, the ability to add value to the group etc. are present (Allen, Duch & Groh, 1996).

Having all of this in mind, the goal of the research was to identify a proper Web 2.0 tool to be used as support for PBL. The application must cover the needs for the Maastricht 7 steps method and the research team will check its possibilities but also its acceptance by the students.

## 2. Material and methods

The scope of this research was to identify, implement, test and assess a web application which covers the facilities necessary for Problem Base Learning at the curriculum level; secure, providing a collaborative environment, availability, and easy to use. The application must fit the existing hardware and software infrastructure and the implementation must be made without any supplementary costs – no license fee, no supplementary software costs. The installation, configurations, maintenance process and administration tasks must easy to be performed, for the application to fit the existing human infrastructure – there should be no specialized personnel for web-based application. The community of users for this application must be large enough to ensure that the most common problems are documented and the most frequent issues could be solved with one's own resources.

On the following infrastructure:

- OS: Debian 8
- Web Server: Apache 2.0
- DB: MySQL 5.5.49
- PHP 5.6

We installed a Moodle version 2.9 (current 3.0.3+)

To test the platform we use a sample of 21 students enrolled in first year at the Faculty of Medicine, who studied Biostatistics, part of the regular curriculum. The students were volunteers to join the study, the participation at the study ensuring a bonus at the final grade on Biostatistics exam. Before the study, the students had no previous experience in PBL or in using Moodle and they were regular computer users, having no advanced IT skills.

There were two group meetings, the time between them being one week. At both meetings, all 21 students participated, under the supervision of a facilitator. At the first meeting, before the problem was presented, the Moodle instance was presented to the students and they were instructed how to access the platform, how to log at the platform and how to access the section reserved for this purpose – approximately 15 minutes of instruction. After that, the problem based learning method was presented to the students, and they received the text for a real life scenario which involves knowledge in biostatistical area – collecting and analyzing data. In approx approximately 40 minutes, being guided by the facilitator, the students debated the problem, found 10 educational objectives and assigned each objective to be handled by a group of 2 or 3 students (9 educational objectives – groups of 2 students, 1 educational objective – group of 3 students). Every student was assigned to a group; no students handled more than one educational objective. The Moodle platform was used as a support to collect both educational objectives and the responsible people. Having one week time, the students had the task to put the adequate educational material for learning the specific topics and to study it, and at the second meeting the students put together the pieces of the puzzle and solved the problem.

After solving the problem, they were asked to complete a questionnaire with questions about their opinion on the PBL and on the issues they confronted when they used Moodle as support tool for PBL. The questionnaire was created using Google Forms and contained 8 questions with closed answer and one question with open answer. The questions are presented in Table 1.

**Table 1. The Evaluation Questionnaire**

Topic	Issue	Type
	General level of difficulty in use	Closed question 1 –Very difficult ... 4 No difficult at all
Moodle	Technical issues	Closed question 1 –A lot ... 4 None
	Enjoyable	Closed question 1 –I hate it ... 4 It is good
	Willing to use in future	Closed question 1 –Never ... 4 Very much
	Moodle as support for PBL	Closed question 1 –Inappropriate ... 4 Appropriate
PBL	Is it interesting?	Closed question 1 –Not at all ... 4 Yes, very

	Team work	Closed question 1 –I hate it ... 4 I love it
	Compare with traditional method	Closed question 1 –Not as good 2 Same results
Both	What do you like most?	Open question

The data collected from the questionnaires was analyzed using Microsoft Excel 2010.

### 3. Results

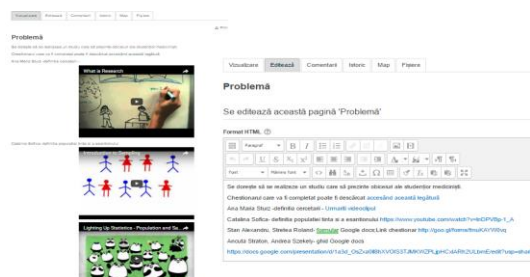
#### *Evaluating the platform*

The implementation of Moodle is available at <http://web.umfluj.ro/moodle/>

In order to be appropriate to be used as support for Problem Based Learning, Moodle must provide at least these characteristics: security, collaborative environment, availability, and easy to use.

To access the reserved section, each student had to log in using authentication credentials. Using the administration interface we were able to import the credentials which students were using to log on the department’s LAN, so there was no need of supplementary credentials. Once they log on, the students were able to access only the section designed to be support for PBL.

To ensure the collaborative environment, we used the Wiki object from the Moodle activities repository. The result was a document space which can be accessed and edited simultaneous by all the users, on which the students were able both to add the educational material and to learn from the educational material added by the other members of the group. A snapshot of the workspace can be found in Figure 1.



**Figure 1. The PBL workspace. View mode –left, edit mode – right**

In total, the students used 4 videos from YouTube, two external websites and 6 custom files (word documents, excel documents, PowerPoint presentation and one avi file) as educational material. To assess the availability issue, we motorized both the platform and the Apache web server. During the period of the study, the application was up and running, the logs recorded 0 failures. We were able to install and configure the Moodle without having many difficulties, being able to solve the issues using the Moodle manuals. The students were able to use the application as well, after only 15 minutes of verbal instruction. The Moodle administration interface is very intuitive so there were no problems in setting up and administrating the PBL workspace.

#### *The student’s opinion*

All of the 21 students completed the questionnaire. The distribution of the answers is presented in Table 2.

**Table 2. The Answers**

Topic	Issue	Responses (%)			
		1	2	3	4
Moodle	General level of difficulty in use	-	-	38	62
	Technical issues	-	-	67	32
	Enjoyable	-	14	67	19
	Willing to use in future	-	-	10	90
	Moodle as support for PBL	-	-	-	100
	Is it interesting?	-	10	71	19
PBL	Team work	5	10	62	24
	Compare with traditional method	43	57		

#### 4. Discussion

When we consider which application could be appropriate to be the support for PBL, Moodle was our number one choice, because we had very good experiences in other domains (Calinici & Drugan, 2015; Calinici & Istrate, 2013). However, the experience in using Moodle is not a factor for decrease of the Moodle qualities. The installing process is well documented, the administration interface is very clear and the platform has a user-friendly interface. The availability of a large collection of templates, allow us to integrate the design of the platform to the other web applications of the department. Moodle fits perfectly with our infrastructure, but our experience showed that Moodle can be used on other different infrastructures (e.g. Windows). With small effort we were able to configure this instance of Moodle to be used not only in browser from different devices and OS (Windows, MacOs, Android) but as mobile app as well.

The specific of medical sciences assume, by tradition, the assimilation in the first years of a very big amount of information. This combined with the cultural tradition which is very professor-centered, make the implementation of PBL in the late years difficult, so it was a big advantage that we use first year students. On the other hand, because of the lack of medical knowledge, it is difficult to create appropriate scenarios so PBL method could be used.

The literature suggests that PBL should be used on small groups (Munteanu & Rednic). We had violated this assumption because our main focus was not in the learning process but in the evaluation of the IT platform. An interesting fact about the educational material used by the students for learning the topics identified in PBL section was that they use almost the same proportion of traditional material – documents, web-sites and YouTube videos. This is an advantage of using IT tools, allowing using multimedia as learning material. In fact, almost any object that can be seen in browser could be used as learning material with Moodle. This property leads to ethical issues, regarding the copyright of the learning material.

All of the students agreed that Moodle is appropriate to serve as a support for Problem Based Learning process, most of the students enjoyed using it and were willing to use it in different contexts. However, only half of them believe that they can obtain at least the same results like using the traditional method for teaching and learning.

The study has limitations. There are many other web applications which can be used as support for PBL.. A future research can be conducted to compare the use of Moodle in PBL so as to find out which application fits best to specific needs. Another limitation is provided by the sample of the students. They were not selected randomly, they were volunteers, motivated to use the application.

Last but not the least we must state once again that the success of the PBL method is in the level of the involvement of the students. For this, there are other important conditions: The appropriate problem, a good facilitator, and only after that, a good IT instrument for support.

## 5. Conclusions

Moodle proved to be a good Web 2.0 instrument to be used as support for Problem Based Learning. It contains the mandatory features to support the PBL activity: Security, collaborative environment, availability, and it is easy to use. The students in the sample used it without having serious difficulties and considered it appropriate to be use as support instrument for PBL.

## References

- Albanese, M. A. & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Acad Med*, 68 (1), 52-81.
- Allen, D.E., Duch B.J. & Groh, S.E. (1996). The power of problem-based learning in teaching introductory science courses. *New Directions for Teaching and Learning*. 68, 43-52.
- Apache License available at <http://www.apache.org/licenses/LICENSE-2.0> .
- Barrows, H.S. (1980). *Problem-based learning : An approach to medical education*. New York: Springer Pub. Co.
- Barrows, H.S. (1986). A taxonomy of problem-based learning methods. *Medical Education*. 20 (6), 481-486.
- Calinici, T. & Drugan, T. (2015). Using e-learning for developing new skills for administrative staff. *MedEdPublish* 6 (5) Retrieved from <http://dx.doi.org/10.15694/mep.2015.006.0005>
- Calinici, T. & Istrate, D. (2013). Using Moodle as on-line survey instrument in medical education. *Applied Medical Informatics*, 32 (1), 21.
- Changes in MySQL 5.5.49 available at <https://dev.mysql.com/doc/relnotes/mysql/5.5/en/news-5-5-49.html>
- Create a survey using Google Forms available at <https://support.google.com/docs/answer/87809?hl=en>
- Davis, M. H. (1999). AMEE Medical Education Guide No. 15: Problem-based learning: A practical guide. *Medical Teacher*; 21 (2),130-140.
- Debian "jessie" Release Information available at <https://www.debian.org/releases/jessie/>
- Denton, B. G., Adams, C. C., Blatt, P. J. & Lorish, C. D. (2000). Does the introduction of problem-based learning change graduate performance outcomes in a professional curriculum?. *Journal on Excellence in College Teaching*, 11 (2,3), 147-162.
- Duch, B.J., Groh, S. E. & Allen, D.E. (2001). The power of problem-based learning: A practical "how To" for teaching undergraduate courses in any discipline: Stylus Pub.
- Graaff, E.D. & Kolmos, A. (2007). History of problem-based and project-based learning. Rotterdam/Taipei: Sense Publishers.
- Hmelo-Silver, C.E. (2004). Problem-based learning: What and how do students learn?. *Educational Psychology Review*. 16 (3), 235-66.
- Moodle webpage available at <https://moodle.org/>
- Munteanu, V. & Rednic, S. ( 2005 ). Teoria instrucției și dezvoltarea curriculară. Editura medicală universitară "Iuliu Hațieganu" Cluj-Napoca.
- PHP 5.6.0 Release Announcement available at [http://php.net/releases/5\\_6\\_0.php](http://php.net/releases/5_6_0.php)
- Torre, D. M., Van Der Vleuten, C. & Dolmans, D. (2015). Theoretical perspectives and applications of group learning in PBL, *Medical Teacher* 1-7 Early Online.
- Wood, D. F. (2003). Problem based learning. *BMJ Clinical Research*, 326, (7384), 328-30.