

# **Evidences Supporting Problem-Based Learning and its Application in Third Cycle Studies**

Pedagogiskt docenturarbete

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## **Introduction**

The Problem based learning (PBL) has been advocated for some time as a better way of learning especially in the medical field, it gained popularity all over the world and research has been showing that it promotes students' confidence and motivation. It creates a better environment for the students to learn. On the contrary to traditional teaching which results in passive and superficial learning. (Weimer 2002)

In many medical schools PBL is considered as an ideal solution for the complicated medical education. However, the window for criticism and improvement of this strategy needs to be addressed. The method is used widely in undergraduate education, on the contrary, when addressing third cycle education, the role of PBL disappears and the traditional teaching takes over again.

Noting that there is a positive feedback regarding the outcome of PBL as educational methods, in this essay I will try to apply the principals of problem-based learning to find evidence-based knowledge regarding evaluation of PBL as a learning method. In parallel, I will try to apply the principals of PBL to the third cycle studies to find areas where it can be applied in this process.

## **Brainstorming**

The PBL is a learning method where the whole process is centered around the student not the teacher, the learning process starts in small groups where students meet and discuss a proposed scenario, and through brainstorming and discussions the students formulate and detect the problem subject and formulate their study questions and their learning goals. The students usually try to test the knowledge they already have regarding the subject of the problem and plan to search in the literature to come back in the next group meeting and discuss what they have been studying and exchange knowledge. This description can be applied also in the post graduate setting and especially in research projects.

In under graduate setting, parallel to the above-mentioned process the course curriculum coordinators plan certain seminars, lectures or laboratory activities that facilitate the learning process. This curriculum usually has broad learning goals, which the students can use as a guide for their studies. (Cindy E. Hmelo-Silver,2004)

The whole strategy is positive it stimulates active learning, promotes the ability to seek knowledge and information, the student seems to be in control of his/her learning objectives, this as I can see is an open method of learning and the student is the center of the whole process and not the teacher. However, as any strategy it needs to be evaluated and objective outcome measures should be applied to assess if this learning method does produce a good final product or is there areas need to be addressed with possible improvements?

The purpose of using PBL for higher-level medical studies has been described as promoting student-centered multidisciplinary education and laying the foundations for lifelong learning in a future profession (Savery,2006). PBL thus appears to be especially adapted to a future occupational activity in which research is included. However, I have noted that even the PhD students and researchers who have undergone education with a focus on PBL do not implement PBL methods in the research work.

### **Identifying Problem area**

Evidence behind problem-based learning and its application in third cycle studies.

### **Questions**

What are the available evidences supporting PBL as a learning method?

If PBL can be applied in research education for PhD students?

### **Scientific background**

A review work in the literature was undergone and I found several articles about evaluation of PBL as a learning method in different disciplines, most of them were in the medical education field and focusing on under graduate education. The evaluation methods varied including student's surveys, evaluation of the student's grades and other methods.

One study (P. Armbruster et al.2009), which described the implementation of PBL student centered approach in the education of biology for students in Georgetown University, Washington DC, the implementation was done for two years and then evaluation of the outcome by doing student surveys and monitoring the students' grades before and two years after introduction of the PBL strategy. The authors motivated in the introduction that previous research has been showing improved outcomes after applying PBL methods. The authors looked after the evaluation done by the students before implementation of the new strategy and the student's attitude was generally disappointed, most of the students rated the course and the lectures as boring and non-relevant to their future and that resulted in poor attendance and bad outcome in the examinations. However, after implementation of the new student centered strategies including problem solving activities, the students attitudes changed positively and their achievement was significantly improved compared to the previous strategies, but the students in this studies were commenting negatively on the frequent quizzes they had on weekly basis and thought it was a burden (15% of the students). The authors also pointed out that restructuring the course consumed a significant part of their time and required attendance to workshops and training to be able to reach the final new course design.

A review article (Cindy E. Hmelo-Silver, 2004) is questioning what do really students learn in a PBL based learning system. Do they really widen their scientific basis, do they really learn to solve problems and are they promoting their skills? This review tried to touch this hot issue and bring answers to those questions.

The review focused first that many studies similar to the study mentioned before (P. Armbruster et al.2009) have compared the traditional teaching to PBL regarding the student performance in examinations and student surveys but more complex outcome measures need to be evaluated in this case. Several meta-analysis of students doing the national board of medical education part 1 (NBME 1) examination in USA, which tests the basic knowledge of medical students (in the form of multiple-choice questions). PBL students achieved slightly lower than traditional students did. However, in (NBME 2 exam) which tests the students' clinical knowledge and other clinical performance tests, the PBL students achieved slightly better. Another meta-analysis (Dochy et al. (2003) showed that PBL had no effect on knowledge based on facts but coming to knowledge application then PBL students scored slightly better.

Another aspect that was studied by (Patel et al. (1991, 1993) comparing PBL and traditional students in the abilities to give explanations of a clinical problem and PBL students showed more elaborative abilities to give explanations rather than traditional students but there explanations were more prone to error.

An Interesting study (Hmelo, C. E. (1998) that compared two groups of medical students (PBL vs traditional) in finding explanations for medical problems in three time points: at first week after classes, three and seven months. The students were evaluated at each stage for the accuracy and the application of scientific concepts. In the first phase the students were similar, but later at 3,7 months the PBL students were more accurate and coherent and applied the scientific concepts in a better way. This ended with the conclusion that PBL students can construct and apply flexible scientific knowledge.

Another areas rather than medicine were the PBL was showing positive results such as engineering, statistical reasoning, psychology, even in high school education. However, the application of PBL in other areas is limited because of the lack of resources such as class tutors and facilitators.

Gwendie Camp (1996) discussed the phenomenon of the rise and popularity of PBL and whether if this phenomenon is going to continue or disappear from education especially medical education. Reasons behind PBL gaining its popularity can be attributed to the need to improve the students' attitudes towards more positive attitude that was achieved by introducing PBL. The need to introduce new strategies in the form of PBL to promote the recruitment of students, besides, that PBL is a good strategy for adult learning. Moreover, building PBL on constructivism principal makes it very applicable to learning and makes it fit for wider range of disciplines where PBL is applied effectively. One other motivator for shifting to PBL is the thought of 'not missing the boat' as a revolutionary change in education. The authors speculated the future after PBL will be based on computer based (virtual reality) patients or tutorial groups applying similar learning objectives to reach their goals. In conclusion the author states that PBL is expected to be a dominant method especially in medical learning however the application of the PBL principal will vary between different places ranging from full application to hybrid form mixing between PBL and traditional medical teaching. However, the author is still very careful in his expectations for the PBL.

L.Berkson (1993), reported difficulty in distinguishing between PBL and traditional students. In addition, interestingly it reported that PBL could be stressful on both the teaching body and the student. Similarly it reported that economically the PBL program is more expensive and resource consuming than traditional learning. The author in this article could not distinguish the end product of PBL/Traditional methods and reflected that the end product is very similar or can be the same and this may suggest that both methods can meet and the best benefit can be obtained by merging the best features out of the two strategies.

In Summary, PBL as a learning/teaching method fits in complex problem-solving disciplines such as medical education; it helps students to correlate facts to actual learning problems. They develop skills to acquire knowledge and to adapt this knowledge to be applied in their future carriers. However, we should be careful and plan further research to test if these potential advantages are realistic.

The study (P. Armbruster et al.2009) is comprehensive, it applied the pre and post evaluation principal to show the difference between the two strategies, the study showed better achievement by applying the PBL strategy but also complained about the frequency of the short examinations and the authors pointed out that the restructuring was time consuming. I can see that this is a very objective evaluation, which confirms the hypothesis postulated from the beginning. However, I still need to hear more from the students regarding the new strategy. What are their opinions? In addition, if they really think learning in this way is making different or burdening them extensively?

Moreover, in several studies, the PBL has shown improvement in the way students construct flexible knowledge and problem-solving skills and collaborative work. However, other observations must be drawn cautiously, first most of the research is focused on medical studies and most of the methods used for the evaluation was the use of pre and post-test and quasi experiments but it lacks controlled experiments. The conclusions about flexible knowledge and problem-solving skills lacks focus on motives and cooperation. Moreover, the application of PBL in other areas than medical studies is still a challenge especially for high school students.

### **Application of PBL in third cycle studies**

There are studies that report positive results from short PBL courses within a PhD student education. An example describes that the students learned: to filter information by making the study questions more focused and by critically reviewing the scientific value; give and receive constructive feedback; and that group learning provided a broader and deeper perspective, including experiences of having different roles within the group. The authors acknowledge that it is possible that the results had varied if the course had been mandatory for all within the doctoral program, however, the study recommended that inclusion of PBL even in a simplified form in other conventional courses for PhD students (Larin H, 2010).

In a review from 2014, results have been compiled from 15 randomized studies investigating the effect of PBL on (further) medical education. The overall result showed that PBL did not provide greater knowledge gain, better application of knowledge, or better health effects for patients compared to control groups in which either conventional teaching methods were used or no interventions were made (Al-Azri H, 2014).

It has been suggested that the explanation behind the fact that PBL does not automatically generate self-directed learning driven by internal motivation later in working life may be that learning during a PBL education is rather controlled and driven by course syllabuses, examinations, and the group (Schmidt HG, 2000).

In a dissertation, the extent to which the PhD student has developed into a competent researcher is evaluated. It is reasonable to assume that the most important assessment bases are related to the extent of success in the whole research group. Factors that are often mentioned are the ability to discuss their research findings and argue based on relevant literature, an analytical approach to processing and interpreting data, being able to identify new knowledge when generated or presented within their field, the ability to generate theoretical models based on research results, being able to describe the theoretical

framework for the research area and how the relationships are between different theoretical positions (Van Schalkwyk SC, 2016).

The supervision of doctoral students can be understood as a creative process consisting of five aspects: the agreement to work as a team of good communication and flexibility for a high end learning product, to convey security and experience in a long and often frustrating process through presence, interest, and self-awareness, as well as the ability to use general principles in specific situations (habits of mind), knowledge and experience generated during the research and writing of scientific publications (scholarly expertise), to be able to master technical / practical skills in one creative way including knowing when, where, how, and why they should be used , and placing their own research in a larger network of active researchers (contextual expertise) (Halse C, 2010).

## **Reflections**

According to (Problem baserat lärande, Vision, Värdegrund och Verktyg, Medicinska fakulteten, Linköping Universitet, 2017), PBL has several principals, however, after reading these principals deeply, I see that these principals are applicable for third cycle studies. The application of PBL in the courses that the PhD students undergo is noted and working in small groups and that students are the center of the learning process and are taking the responsibility for their education is pronounced. However, I see in my work as a PhD co-supervisor that we can extend and apply those principals in other areas in the research education.

One area that the I can see where PBL can be applied is the writing of the PhD research plan by the student. Construction of this plan can be done in different ways; one common way is that the supervisors help the student to write the plan based on their experience and the aims for the whole project. However, this method seems very passive for me , A better method is to apply the PBL principals to this process and instead of giving instructions to the student, construction of a small working group including the student and the supervisors and other interested members of the team and discuss the project plan according to PBL principals where a problem identification and definition can be agreed on and areas for deficiency in knowledge are identified and proper questions are stated and goals are set which in other words can be translated to a project plan.

Other areas that I think PBL can be applied in third cycle study is the process of scientific writing of manuscripts where several problems are usually faced especially for un-experienced authors. The PBL principals can be applied to help the student to formulate their questions and identify the aims and search in the literature and finally reach to an end product which is scientifically acceptable.

## **Conclusion**

My knowledge about PBL as a pedagogic model has improved after this review of literature, but I still believe that PBL needs to be more objectively evaluated. In addition, PBL need to be developed in different aspects to be fitting in different disciplines. The economic burden of PBL is a very hot topic and need to be furtherly investigated.

Based on the above discussion, the process of PhD studies is based mainly on developing problem solving skills on higher levels, including working in a group, identifying questions and areas that needs to be addressed to answer the proposed study questions. The ability to interpret the results and apply them in real life situations. Shortly, The PBL principals appear in the context of the third cycle studies but need to be more identifiable or structured. The PhD courses are areas where PBL can be implemented on wider scale. Moreover, small group work (supervisor, Student) is a good area to implement PBL on wider scale to improve the students research capabilities and increase the effectiveness of the small working group.

There is some evidence that PBL provides favorable results regarding application of knowledge and problem solving. However, it is difficult to assess whether PBL is the best education because there are no randomized studies comparing equivalent educational approaches and evaluating the outcomes for PBL in third cycle studies. However, it would be interesting to investigate more in order to understand how learning can be facilitated, especially in the most frustrating parts of the research work.

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