

# PBL: step by step

a guide for students and tutors

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## Introduction

Problem-based learning (PBL) is a method of education in which the student is at the center and the teacher is guide on the side. In PBL students themselves are responsible for their own learning process and have to a certain degree control over the choice of literature. Education does not only take place in lecture halls, but mostly in small groups of about ten students. In these tutorial meetings students discuss “problems” using a procedure called the seven-step approach.

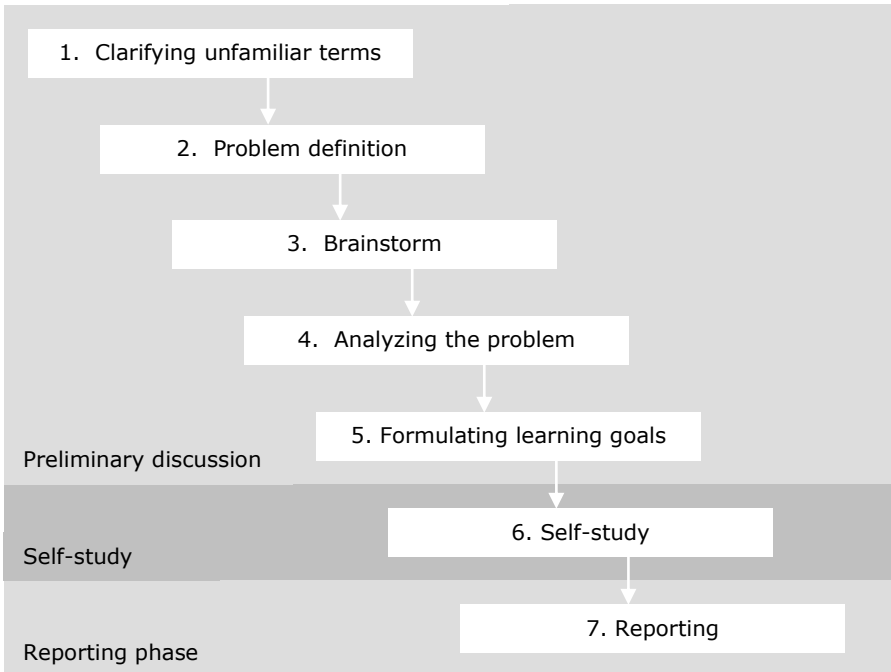
In order to support the learning process, there are a number of roles in the tutorial group. One student acts as chair, another as scribe and the whole process is supervised by a tutor. Discussing problems with the seven-step approach and performing the tasks of chair, scribe or tutor requires a number of skills.

In PBL the group is jointly responsible for the quality of the learning process and for the success of the meeting. It is therefore important that all students prepare well, participate actively in the tutorial meetings, and explain the studied materials in their own words.

This booklet gives an overview of the procedure of the seven-step approach. It also introduces skills that are required to perform the role of chair, scribe and tutor. This booklet can be used as a starting point for practice with the seven-step approach and the different roles in the tutorial group. It can be used by both students and tutors to determine what concrete skills they need to master in order to promote their own performance and that of the group.

In the first part of the booklet the seven-step approach is explained. Then, the skills of the chair and the scribe will be clarified. Both general skills and specific skills for every step of the seven-step approach will be presented. Next, attention is given to the skills of the tutor, as supervisor of the learning process, and to the evaluation of the group process. Finally, theoretical background of PBL is discussed to provide insight in the effect that working with PBL has on the learning process of a student.

## The seven-step approach



## The seven steps

### Step 1: clarifying unfamiliar terms

Unclear terms and concepts in the problem description are clarified, so that every group member understands the information that is given.

### Step 2: problem definition

The problem is defined in the form of one or more questions. The group has to agree upon the phenomena that need to be explained.

### Step 3: brainstorm

The preexisting knowledge of group members is activated and determined. This process entails the generation of as many explanations, ideas, and hypotheses as possible. The ideas of all group members are collected, without critical analysis.

### Step 4: analyzing the problem

Explanations and hypotheses of the group members are discussed in depth and are systematically analyzed. Ideas from the brainstorm are ordered and related to each other.

### Step 5: formulating learning goals

Based on contradictions, obscurities, and ambiguities from the problem analysis, questions are formulated that form the foundation for the study activities of the group members. In short, it is determined what knowledge the group lacks, and learning goals are formulated on these topics.

### Step 6: self-study

In the self-study phase, group members search for relevant literature that can answer the questions in the learning goals. After studying this literature, group members prepare themselves for reporting their findings in the next tutorial meeting.

### Step 7: reporting

After reporting what sources group members have used in their self-study activities, a discussion of the learning goals takes place based on the studied literature. Group members try to synthesize what they have found in different sources.

## Skills of the chair and the scribe

*The chair is the group member who structures the discussion of a problem or the reporting of the findings. He or she directs the interaction between group members to enable an effective discussion with respect to both process and content. The scribe supports the chair.*

### General skills

Skills of the chair that are important in more than one step of the seven-step approach:

- ensuring a correct application of the seven-step approach
- structuring the tutorial meeting
- stimulating all group members to contribute to the discussion
- summarizing and paraphrasing contributions of group members
- asking questions and promoting the depth of the discussion

Skills of the scribe that are important in more than one step of the seven-step approach:

- listening actively, selecting important points and noting them down
- if necessary: asking questions to clarify or check if what noted down is correct
- expressing information succinctly, using keywords and abbreviations
- structuring information on the board, if possible by visualizing information in a drawing or table
- writing quickly and clearly

### Step 1: clarifying unfamiliar terms

Skills of the chair:

- invites group members to read the problem
- checks if everyone has read the problem
- checks if there are unfamiliar terms in the problem
- concludes and proceeds to the next phase

Skills of the scribe:

- creates a lay out on the smart board
- notes down the unfamiliar terms



## **Step 2: problem definition**

Skills of the chair:

- asks the group for possible problem definitions
- paraphrases contributions of group members
- checks if everyone is satisfied with the problem definitions
- concludes and proceeds to the next phase

Skills of the scribe:

- notes down the problem definitions

## **Step 3: brainstorm**

Skills of the chair:

- allows all group members to contribute one by one
- summarizes contributions of group members
- stimulates all group members to contribute
- summarizes at the end of the brainstorm
- makes sure that a critical analysis of all contributions is postponed until step four

Skills of the scribe:

- makes brief and clear summaries of contributions
- distinguishes between main points and side issues

## **Step 4: analyzing the problem**

Skills of the chair:

- makes sure that all points from the brainstorm are discussed
- summarizes contributions of group members
- asks questions and promotes depth in the discussion
- makes sure the group does not stray from the subject
- stimulates group members to find relations between topics
- stimulates all group members to contribute

Skills of the scribe:

- makes brief and clear summaries of contributions
- indicates relations between topics and makes schemata

### **Step 5: formulating learning goals**

Skills of the chair:

- asks for possible learning goals
- paraphrases contributions of group members
- checks if all obscurities and contradictions from the problem analysis have been converted into learning goals
- checks if everyone is satisfied with the learning goals

Skills of the scribe:

- notes down the learning goals

### **Step 7: reporting**

Skills of the chair:

- prepares the structure of the reporting phase
- makes an inventory of what sources have been used
- repeats every learning goal and asks what has been found
- summarizes contributions of group members
- asks questions and promotes depth in the discussion
- stimulates group members to find relations between topics
- stimulates all group members to contribute
- concludes the discussion of each learning goal with a summary

Skills of the scribe:

- makes brief and clear summaries of contributions
- indicates relations between topics, makes schemata or concept maps
- distinguishes between main points and side issues

## **Skills of the tutor**

*The role of the tutor is to support and supervise the learning process of the members of the tutorial group. The tutor supports the process of independent learning with respect to both process and content.*

### **Attitude**

The tutor has an open attitude towards students and shows interest in their (study) activities. He or she does not act as a traditional teacher, but asserts the role of supervisor. The tutor observes and analyses the group process and intervenes, if necessary, by asking questions and giving examples, seldom by giving information directly. He or she is able to communicate with students both formally and informally and is able to raise a matter in an understandable fashion.

### **Tutor skills with respect to the process**

*A first part of the task of the tutor is to supervise the learning process of students with respect to the process. The tutor promotes processes in the tutorial group that support learning and stimulate cooperation among group members.*

The tutor:

- ensures an efficient and effective application of the seven-step approach
- supports the chair and the scribe
- stimulates a well-balanced contribution of group members
- asks questions to induce discussion
- provides feedback to students about their own performance and the group performance

## **Tutor skills with respect to the content**

*A second part of the task of the tutor is to supervise the learning process of students with respect to the content. The tutor uses his or her knowledge of the field in the discussion and reporting phase to ensure that the knowledge and theories on which the problem is based is discussed well.*

The tutor:

- stimulates depth in the discussion
- uses questions to promote depth and to help students identify their own misconceptions
- gives information, but only to get the discussion going when the group is stuck
- stimulates group members to find relations between topics
- chooses the right moment for an intervention
- makes sure that the discussion does not become too broad and a clear distinction is made between main points and side issues

## Evaluating tutorial group meetings

*After each discussion there is an opportunity to reflect on the functioning of the group, the different roles within the group and of the individual group members. The goal of this reflection is to optimize cooperation in the group and thereby to optimize the learning process.*

### Giving and receiving feedback

The aim of giving and receiving feedback after a tutorial group meeting is to make group members more conscious of their behavior and the effect of their behavior on others and on the functioning of the group as a whole. This entails that the members of the group need to be able to criticize each other in a constructive way. It also entails that group members need to be able to deal with criticism from other group members.

### Effective feedback

There are a number of rules of thumb that can improve the effectiveness of feedback. Feedback needs to be:

- descriptive and not judgmental
- specific, directed at concrete behavior
- useful for the receiver
- not only negative: positive feedback stimulates the receiver to show the positive behavior more frequently
- delivered from the perspective of the feedback provider: "I feel ..."

## Overview of student skills in PBL

### Preliminary discussion

Step	Description	Chair	Scribe
1.	<p><i>Clarifying unfamiliar terms</i></p> <p>unfamiliar terms in the problem text are clarified</p>	<ul style="list-style-type: none"> <li>invites group members to read the problem</li> <li>checks if everyone has read the problem</li> <li>checks if there are unfamiliar terms in the problem</li> <li>concludes and proceeds to the next phase</li> </ul>	<ul style="list-style-type: none"> <li>creates a lay out on the smart board</li> <li>notes down the unfamiliar terms</li> </ul>
2.	<p><i>Problem definition</i></p> <p>the tutorial group defines the problem in a set of questions</p>	<ul style="list-style-type: none"> <li>asks the group for possible problem definitions</li> <li>paraphrases contributions of group members</li> <li>checks if everyone is satisfied with the problem definitions</li> <li>concludes and proceeds to the next phase</li> </ul>	<ul style="list-style-type: none"> <li>notes down the problem definitions</li> </ul>
3.	<p><i>Brainstorm</i></p> <p>preexisting knowledge is activated and determined, hypotheses and ideas are generated</p>	<ul style="list-style-type: none"> <li>allows all group members to contribute one by one</li> <li>summarizes contributions of group members</li> <li>stimulates all group members to contribute</li> <li>summarizes at the end of the brainstorm</li> <li>makes sure that a critical analysis of all contributions is postponed until step four</li> </ul>	<ul style="list-style-type: none"> <li>makes brief and clear summaries of contributions</li> <li>distinguishes between main points and side issues</li> </ul>
4.	<p><i>Analyzing the problem</i></p> <p>ideas and hypotheses are discussed in depth and are systematically analyzed and related to each other</p>	<ul style="list-style-type: none"> <li>makes sure that all points from the brainstorm are discussed</li> <li>summarizes contributions of group members</li> <li>asks questions and promotes depth in the discussion</li> <li>makes sure the group does not stray from the subject</li> <li>stimulates group members to find relations between topics</li> <li>stimulates all group members to contribute</li> </ul>	<ul style="list-style-type: none"> <li>makes brief and clear summaries of contributions</li> <li>indicates relations between topics and makes schemata</li> </ul>
5.	<p><i>Formulating learning issues</i></p> <p>lacking knowledge is determined and learning goals are formulated on these topics</p>	<ul style="list-style-type: none"> <li>asks for possible learning goals</li> <li>paraphrases contributions of group members</li> <li>checks if all obscurities and contradictions from the problem analysis have been converted into learning goals</li> <li>checks if everyone is satisfied with the learning goals</li> </ul>	<ul style="list-style-type: none"> <li>notes down the learning goals</li> </ul>

*Self-study phase*

<b>Step</b>	<b>Description</b>	<b>All group members of the PBL sessions</b>
6.	<i>Self-study</i>  answers to the learning goals are found by means of studying relevant scientific resources	<ul style="list-style-type: none"> <li>• look for the relevant scientific resources</li> <li>• carefully select those part of the resources needed to answer the questions in the learning goals</li> <li>• study the literature and other resources based on the learning goals</li> <li>• formulate answers to the questions in the learning goals for example by making an abstract or concept map</li> <li>• study in depth in order to apply the learned materials and report the findings in their own words</li> </ul>

*Reporting phase*

<b>Step</b>	<b>Description</b>	<b>Chair</b>	<b>Scribe</b>
7.	<i>Reporting</i>  findings from the literature are reported and answers to the learning goals are discussed	<ul style="list-style-type: none"> <li>• prepares the structure of the reporting phase</li> <li>• makes an inventory of what sources have been used</li> <li>• repeats every learning goal and asks what has been found</li> <li>• summarizes contributions of group members</li> <li>• asks questions, promotes depth in the discussion</li> <li>• stimulates group members to find relations between topics</li> <li>• stimulates all group members to contribute</li> <li>• concludes the discussion of each learning goal with a summary</li> </ul>	<ul style="list-style-type: none"> <li>• makes brief and clear summaries of contributions</li> <li>• indicates relations between topics, makes schemata or concept maps</li> <li>• distinguishes between main points and side issues</li> </ul>

## Theoretical background of PBL

This booklet is full of suggestions about what is necessary to work with and survive in problem-based learning. These suggestions all have a rationale: there are *reasons* to organize education around problems; to tackle these problems with the seven-step approach; to invest time in analyzing the problem; or to learn how to chair a tutorial meeting. These reasons are all based on scientific research and this research is still going on. We will only present them to you briefly. If you would like to learn more about the background of problem-based learning you are advised to read some of the literature mentioned in the reference list.

Reasons for PBL:

- Learning by discussing problems has been proven to make the study material *more interesting*. If you first discuss a problem with others, you will be more curious about the explanations for phenomena in the problem. Scientist says you are more intrinsically motivated to study the literature.
- In more traditional education, there are only a few links to the profession that you might choose after graduation or the practical relevance of certain knowledge. Because the problems that you will see in the tutorial meeting are often derived from your future professional practice, you are able to obtain knowledge *in a context that is relevant* for the latter application of that knowledge. This is of great importance for your ability to apply knowledge you have learned during your study to novel situations. Learning in context leads to better *transfer* of the knowledge obtained.
- Research has shown that new knowledge is retained better when you make an effort to determine what you already know about the subject *before* you start learning. In a sense, this *activation of prior knowledge* prepares your brain for the storage of new information. This information can now be embedded into existing knowledge in your brain. Activation of prior knowledge is exactly what you do in step 3 of the seven-step approach. By brainstorming, you determine what you already know about the subject, thereby preparing your brain for storing of new knowledge.



- Activation of prior knowledge is an important mental activity, but it is not sufficient. Research has also indicated that knowledge becomes more useful, easier to retrieve from memory and that it can be retained for longer periods of time if it is elaborated on.

How can you elaborate on your own knowledge? You can do this by explaining matters to other people or by asking other people what their view is and then thinking about this view. Thus, *elaboration of knowledge* is an important activity. In step 4 of the seven-step approach this activity takes place, based on prior knowledge that has been activated previously; in step 7 you elaborate on new knowledge that you have obtained during self-study activities. Both steps are essential for learning new information and preparing obtained knowledge for application.

- Studying is more structured when you have a plan about how you are going to do this; when you know what you want to know. That is why formulating *learning goals* (step 5 of the seven-step approach) is so important. Learning goals direct learning and help you to decide what is important and what is less important.
- In PBL, you are asked to select your own sources of information from the library and the internet. This is precisely what you are going to do later, in the professional practice. There will be no teacher then who tells you what to study or who gives you homework. So, if this is going to be the case for you later on, it is best to start right now: being responsible for your own learning.
- The study you have started is scientific. This means that an important goal of your education is to provide you with a scientific attitude. This is the reason why a lot of attention is given to scientific methods, statistics, and doing research yourself. The seven-step approach has the same goal; it is a metaphor for scientific thinking and doing. Science also begins with problem, phenomena that are puzzling and require an explanation in terms of underlying processes or principles. A researcher confronted with such a problem will activate prior knowledge and elaborate on this knowledge with fellow researcher to try to formulate a theory that can explain the problem (step 3 and 4 of the seven-step approach). This theory is then tested.

This entails the study of literature and the design of experiments. You, as a scientist-to-be, focus primarily on the literature. To get a good overview of the literature it is essential that you study multiple sources (as scientist try to study all sources). This helps you to better elaborate on your own theory.

- Graduates of problem-based curricula indicate in surveys that they are better able than colleagues educated in traditional curricula to
  - solve problems in their area of expertise
  - cooperate with others
  - chair a meeting
  - work independently and plan their work
  - find information independently and make use of different sources
  
- National surveys in the Netherlands show that students enjoy problem-based learning more than student following a more traditional curriculum. More students in problem-based curricula actually finish their education and graduate faster.

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