What is problem based learning and how to put it into practice?

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Implementing Change

For many years, many higher education institutions have been primarily concerned with producing high quality research, with the writing of grant applications, the submission of papers to peer-reviewed journals, the methodology of scientific presentations and their delivery in prestigious conferences, and the supervision of graduate students.

However, there are other equally important tasks that faculty are called upon to perform such as teaching or even – horresco referens! – administration. Most of us often lack adequate training and expertise in pedagogy and in administration, and while not all faculty have to take on administrative duties, all of us are expected to teach.

Providing high quality education is not easy. Our world has significantly changed over the past decades, and this has changed students' motivation and their expectations concerning the training received at university. Can we still teach the way we were taught ourselves? The answer to that question lies in what awaits students after leaving university: their success will depend on their capacity to adapt to the requirements of their professional environment and to an ever-changing world. To do so, they need to become lifelong learners and master transferable skills such as critical thinking, problem-solving, communication, teamwork, information literacy etc. in addition to disciplinary knowledge and professional know-how. Can such goals be achieved by means of traditional pedagogy mostly based on the transmission of knowledge by teachers? We strongly believe that a radical pedagogical change is necessary to move away from teaching- (and teacher-) centered approaches to learning- (and student-) centered approaches. One of these approaches is **Problem Based Learning (PBL).**

This booklet is a simple guide to the PBL methodology and its implementation. Rather than being a comprehensive review of the abundant literature on the topic, the booklet aims to provide a practical, easy-to-read and playful introduction for those who would like to experiment with PBL in their curricula. To make the reading enjoyable, we have presented the information synthetically, with numerous illustrative sketches. Our objective with this booklet is not only to demystify PBL but also to spark your interest in "implementing change."

Instructions for use

This book is intended to be read in chunks. If you are new to PBL, we advise you to start with the example (chapter 0) and then proceed to chapter 2 on the essential components of PBL.
The ⟩ symbol points either to another section of the guide containing relevant information about the subject being discussed or to a reference in the bibliography.
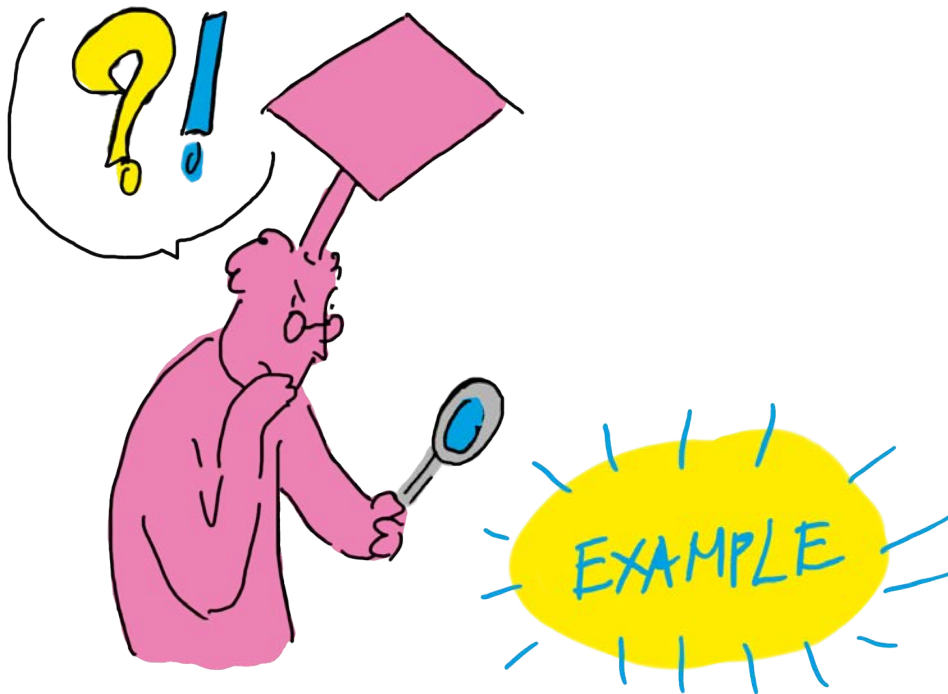
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PBL:
a real-life example (true story)

Imagine...

This is the first week of the school year. About 150 first year students are pre-assigned to groups of 5 to 7. There are 4 groups per room, each of them seated around a table, with sufficient space between the groups.

One teacher, called "tutor", oversees a room; he/she distributes a booklet to every student. This booklet contains the problem statement seen on the next page.
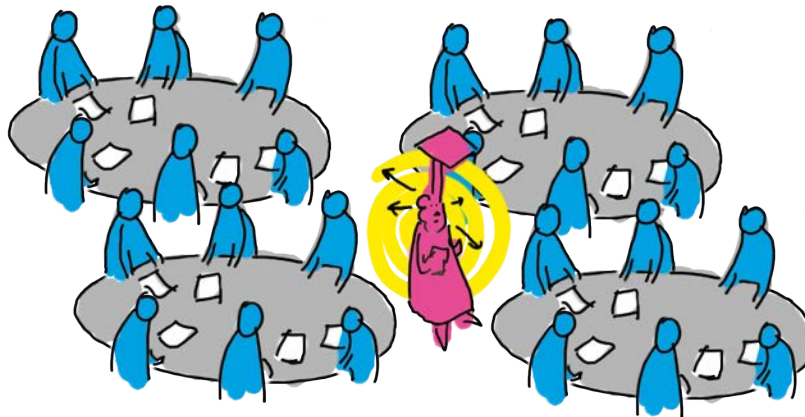
Note that none of the students have had any previous education about law or legal principles!

However, all of them will be required to do internships in companies during their studies. As a result, what sometimes happens with interns is certainly of interest to them.

Furthermore, students were not told in advance what would happen during this first week and they've had no introduction to Problem-Based Learning.

The only prerequisite is internet literacy.

NOTE: In this case, since this is the first PBL unit these first year students are faced with, the problem statement includes more information than will be the case later on, when they will be asked, for instance, to formulate the questions to be answered by themselves.

The problem statement

Your friend John, who is 17, is currently doing a compulsory internship at ACME Inc., a company producing gaskets for the car industry. He is trying very hard, but his supervisor, Mr. George H., is apparently never satisfied with John's work and makes frequent snide and disparaging remarks aloud for everyone to hear in the workshop, while never even telling John how to improve his work. Nobody at ACME Inc. has bothered to inform John of his rights as an intern. John is quite shaken (he requires medical treatment for undue stress), which doesn't help improve the quality of his work...

John talks about his problems to Sheila and Frank, two of his co-interns at ACME Inc. Sheila and Frank are outraged by the way John is being treated; they decide to create a fake Facebook account for ACME Inc, in which they describe how "certain interns are treated" and they post messages incriminating Mr. George H. by name.

John asks for your help and would like you to answer the following questions (be prepared to justify your answers):

1. How does the behavior of Mr. George H. qualify from a legal standpoint?
2. What can John do to address the situation he is in?
3. Which sanctions/penalties (if any) does the law specify for Mr. George H.'s behavior?
4. Is the fact that John is an intern significant according to the law? What about his age?
5. What liability does ACME Inc. hold (if any)?
6. What does the law state about Sheila and Frank's actions?
7. What about damages?

This is what happens (really !)

The **booklet** received during the first tutorial contains additional useful information about resources, about issues to be avoided, etc. It may also contain self-assessment questions to help students assess the quality of their learning.

The **tutor**, meanwhile, helps them along, by asking questions if the students get stuck.

The tutor has been provided with the learning objectives to be achieved (relating to bullying in the workplace and to cyberbullying), as well as with hints about how to guide students' work without actually directing it. He/she makes sure that all relevant questions have been asked by each group in the room during this session.

Monday morning, from 8:30 to 10 am: first « tutorial session » of the PBL unit

In every group, students analyze the assignment (the « problem statement ») and decide
• what is relevant and what is not
• what they think they know about the subject, and what they need to find out to answer the questions – and justify the answers
• how to go about finding out what needs to be found out (resources, work plan)
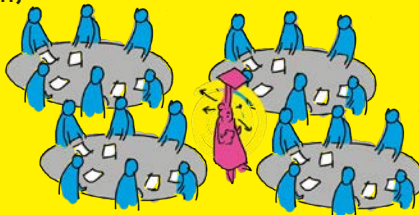
Between Monday morning and autonomous w

Every student executes the agreed-upo
ly: the weekly schedule contains suffi
for autonomous work. In this case, 6
reserved, since a lot of research needs
legal aspects of (cyber-)bullying: findi
the relevant articles within these laws,
dence), preparing the argumentation to

The **tutor** questions every statement uttered by individual members or by the group in order to verify that every student has truly achieved the intended learning objectives defined by the author of the PBL unit, that is to say:

- to cite all relevant laws and explain why they are relevant
- to define workplace bullying according to the law
- to define cyber-bullying according to the law
- to describe what recourse(s) a victim has in case of workplace bullying or of cyber bullying
- to specify penalties and sanctions provided for by the law
- to describe the special case (if any) of minor victims and of minor authors of bullying.

The **tutor** notes possible shortcomings/difficulties in the students' learning process and in their performance in order to inform the designer of the PBL unit, who will use this feedback to improve the unit for the next time it is used.

Thursday evening:
ork

n work plan independent-
icient time slots reserved
to 8 hours will have been
s to be done regarding the
g the applicable laws and
finding case law (jurispru-
justify the answers, ...

Friday morning, from 10 to 11:30 am:
second « tutorial session » of the PBL unit

All students meet again with their group mates in the presence of the tutor. They collectively provide answers to the questions in the problem statement and to any other question that arose during the first tutorial or during the autonomous work.
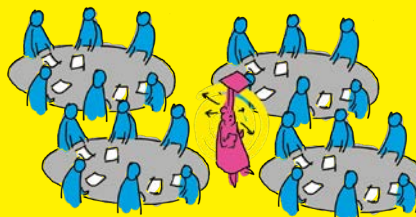
What teachers found out...

- The majority of students did what was expected from them. This was totally unexpected!

- Most students were initially taken aback by the nature of the assignment, but this didn't last very long and had no lasting impact on the quality of their work.

- Few students complained about the legal nature of the subject, supposedly far from their primary area of interest.

- The group work (during the tutorials) was sometimes chaotic: this was a clear indication of the need to pursue student training in PBL methodology (It also highlighted the central role of the tutor).

- Teachers were amazed by the amount of knowledge acquired during the PBL unit, and also by the capacity of most students to correctly apply newly acquired knowledge to the specific case being handled and to similar situations.

- Some students discovered points of law which the authors of the PBL unit hadn't considered themselves (e.g., different notions of the concept of "minor" in French law).

- Many of the questions asked by the students after the conclusion of the PBL unit about the subject matter and about the learning objectives showed a deeper level of understanding than initially expected by the teachers.

- About half of the 150 students expressed anxiety about the prospect of "having to do all the work themselves instead of being taught".
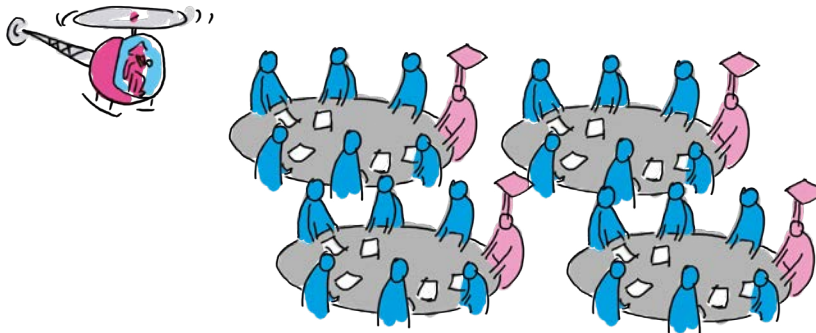
①
Why Problem-Based Learning?
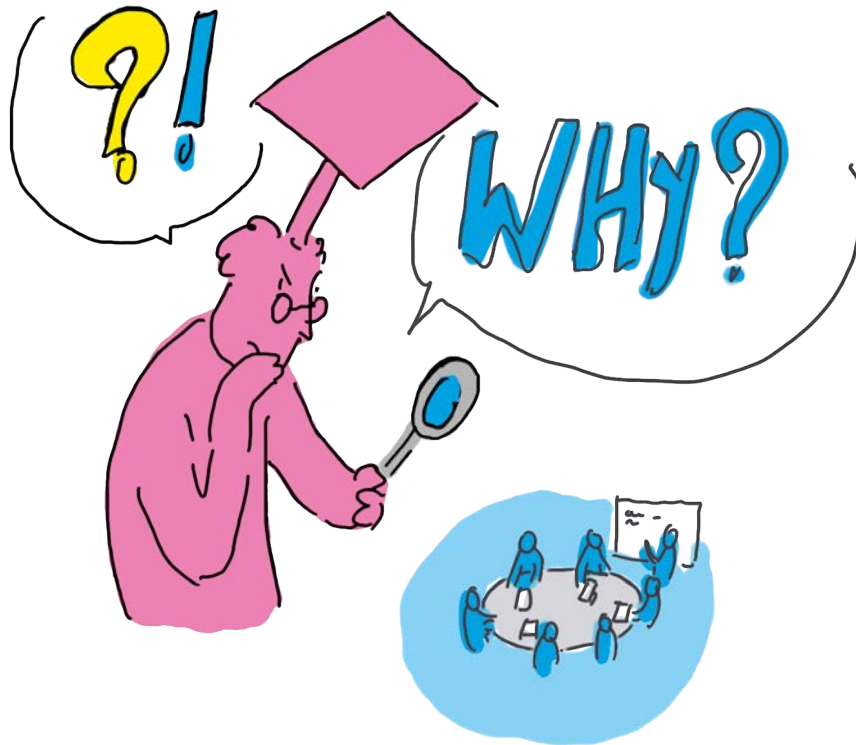
1.1 New expectations for higher education

Higher education has long focused on ensuring the acquisition both of specialized knowledge and competences – needed for specific professional activities – and a basis of general knowledge and competences needed for meaningful participation in and contribution to Society. A new concern has recently emerged: the **employability** of graduates

Employability: "graduates' ability to sustainably hold one's own on the labour market (in employed or independent work, with national or private institutions, at home or abroad)."

European Higher Education Area (in the "Bologna Process")
"The employability of graduates has become a goal that governments around the world have, to varying extents, imposed on national higher education systems."

(Yorke, M. 2006).

Employability of graduates relies not only on disciplinary skills and competences, but also on generic, cross-disciplinary skills and competences. It also requires adaptability .
[AACU VALUE rubrics]

GENERIC, CROSS-DISCIPLINARY SKILLS AND COMPETENCES

- oral and written communication
- problem solving
- quantitative literacy
- teamwork
- civil engagement
- creative thinking
- critical thinking
- ethical reasoning
- global learning
- information literacy
- inquiry and analysis
- integrative learning
- intercultural knowledge and competence
- foundations and skills for lifelong learning

≪ Whereas the world of employment has, by and large, been satisfied with the disciplinary understanding and skills developed as a consequence of participation in higher education, it has been less happy with the development of what have been termed 'generic skills'… ≫

[Yorke, M. 2006]

HOW TO ACQUIRE GENERIC, CROSS-DISCIPLINARY TRANSFERABLE SKILLS AND COMPETENCES - EFFICIENTLY?

Add specific courses and learning activities to the curriculum that are geared towards students' acquisition of generic, cross-disciplinary, transferable skills and competences.

Integrate learning activities geared towards students' acquisition of generic, cross-disciplinary, transferable skills and competences **within disciplinary courses and learning activities.**

The only subject that matters for me is scientific knowledge - period.
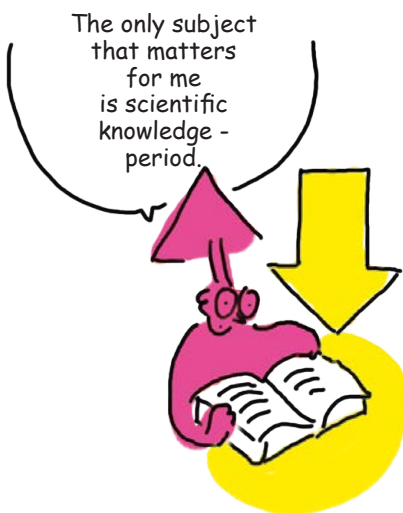
Integration provides context, justification, and thus relevance and meaning for the acquisition of those essential transferable skills.

Acquiring those generic, cross-disciplinary skills and competences during higher education studies is necessary but not sufficient. An additional requirement is that skills and competences acquired and developed in one context can readily be transferred to another: those skills and competences should be transferable. Transferable skills are "higher order skills that enable the person 'to select, adapt, adjust and apply [his or her] other skills to different situations, across different social contexts and perhaps similarly across different cognitive domains."

⊘ [Bridges, D. 1993]

1.2 Why active learning?

TEACHER-CENTERED APPROACH → STUDENT-CENTERED LEARNING

《《 *Higher education is often dominated by a teacher-centered approach; thus, students fail to acquire the bases for becoming successful and mature learners. In order to achieve such a goal, it is important to structure our approach towards a more student-centered approach or engage into active learning processes.* 》》

(B. Wright, 2011)

Students must become responsible for their own learning by being actively involved in the learning process rather than receiving information passively.

The content of a course must be revised so that it aims for more conceptualization rather than memorization, therefore developing the student's ability to self-learn.

student-centered learning

The role of teachers and students is changed: teachers guide students' learning rather than being transmitters of knowledge, while students must not only absorb new information but actively acquire it.

Even ancient Chinese wisdom states that it is what the student **does** that determines what the student **learns**.
It is not enough for the teacher to provide excellent learning opportunities, he/she needs to ensure that students actively engage with these opportunities. Hence, hard thinking about what students are expected to **do** in order to learn is crucial.
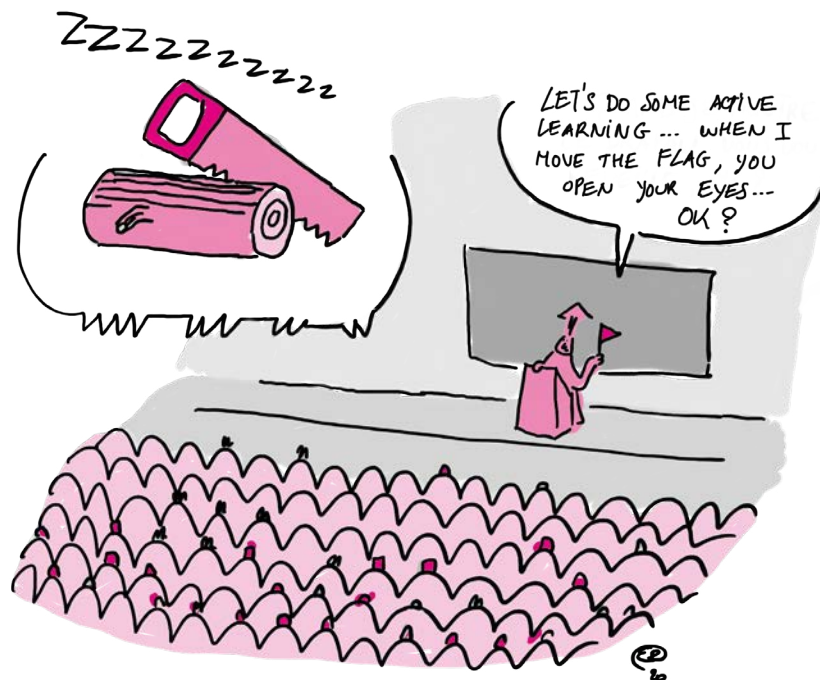
1.3 Why <u>cooperative</u> learning?

Working in cooperative groups yields many positive effects [Johnson & Johnson 2002]:

- mutual stimulation increases individual motivation and efforts
- exposure to multiple viewpoints enhances learning
- better long-term retention
- more positive attitude w.r.t. subject matter
- development of non-technical skills: communication, argumentation, critical thinking, etc.
- improvement of interpersonal relationships between students

> **Positive interdependence:** every member understands that one will more easily reach one's goals if the other members also reach theirs.

One for all, all for one

1.4 Why <u>situated</u> learning?

A frequent way to organize the learning process consists of first learning the underlying theories, and only then applying these theories to actual situations and/or problems.

This **"just-in-case approach"** has many drawbacks, the most important one being that students don't know (yet) why they're expected to learn the theory (not the best way to create and support their motivation).
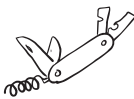
> **Just-in-time:** The overwhelming desire to find ways to handle situations that are perceived by students as authentic creates the need to acquire the necessary knowledge. This is a just-in-time approach to learning theoretical matter.

I learn only when I need to...
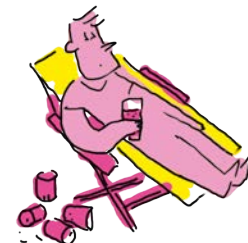
1.5 Why active, cooperative, situated learning in <u>small groups</u>?

Our experience shows that, for efficient collaboration, groups should be neither too small, nor too large.
Small groups (say : fewer than 4 members) often fail to produce enough different viewpoints or approaches for fruitful discussion.
Large groups (say: larger than 7 or 8 members) will make orderly discussion harder than wished for; there is also a risk that the group will split in subgroups with little communication between them.

I am a one-man team...

1.6 Why active, cooperative, situated learning in small <u>tutored</u> groups?

Organizing students in small teams is necessary for fruitful cooperation, but not sufficient for efficiently working together and achieving the results expected by teachers: students need to **learn to work in groups**. One of the roles of the tutor is to support team members in this learning process by making students aware of shortcomings in their group work and by helping them to improve it.
Tutors have many other roles and responsibilities ⊘ **7**

They are learning without me, what's the point of me?
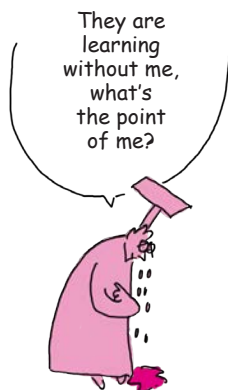
1.7 Why <u>Problem-Based Learning</u>?

Problem-Based Learning is an active, cooperative, situated, and tutored pedagogical method which has shown its ability to help students achieve quite complex learning outcomes (both disciplinary and cross-disciplinary). It also provides a framework for assessing evidence of the acquisition of these skills and competences.

1.8 Some examples of PBL deployment

Problem Based learning was initially introduced in the late 1960s at the Faculty of Medicine of McMaster University (Ontario, Canada). Numerous universities have since followed, and a vast array of programs have adopted the approach (M. Moallen et al. 2019).
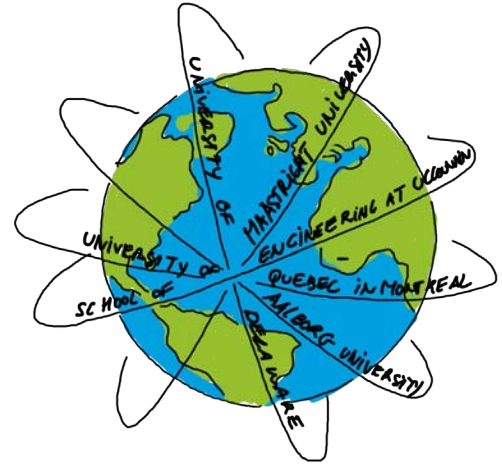
Maastricht University was the second university to adopt PBL in their medical program in the 70s ; since then, they apply the PBL approach to several educational programs. Beyond the method, numerous researchers from Maastricht University have published papers on PBL describing the effectiveness of the approach for student learning.

In 1996, the University of Quebec in Montreal established one of the first science programs based entirely on a PBL approach. Students complete a three-year bachelor in biology through tutorials and laboratory sessions. A high number of students in this program have pursued graduate studies.

Some examples of institutions and programs which have successfully used the PBL method

These are only a few examples of institutions using PBL. Medical curricula have extensively implemented PBL in numerous countries and several engineering schools have followed. The approach has also been extended to social sciences, business, art. Basically it can be adapted to all disciplines and there is extensive literature on the different forms of implementation.

Aalborg University was established in 1974 and it runs entirely on PBL. Its model has been widely recognized leading to the creation of the UNESCO Chair in Problem Based learning in Engineering Education and the Aalborg Centre for PBL.

The University of Delaware has been promoting student-centered pedagogy and, in particular, PBL for over 20 years. Members of the Institute for Transforming University Education (ITUE) have encouraged faculty members to use PBL in their undergraduate classrooms. ITUE has conducted several workshops over the years on the subject and have significantly contributed to promoting PBL in higher education.

The School of Engineering at UCLouvain (EPL) implemented an original problem- and project-based curriculum in the year 2000. An extensive study led by researchers in education sciences has measured the significantly positive impact of the change in pedagogy by comparing two student cohorts in the new (student-centered and active learning) system with two student cohorts in the previous (teacher-centered and course-based) system.

② What are the essential components of a PBL unit?
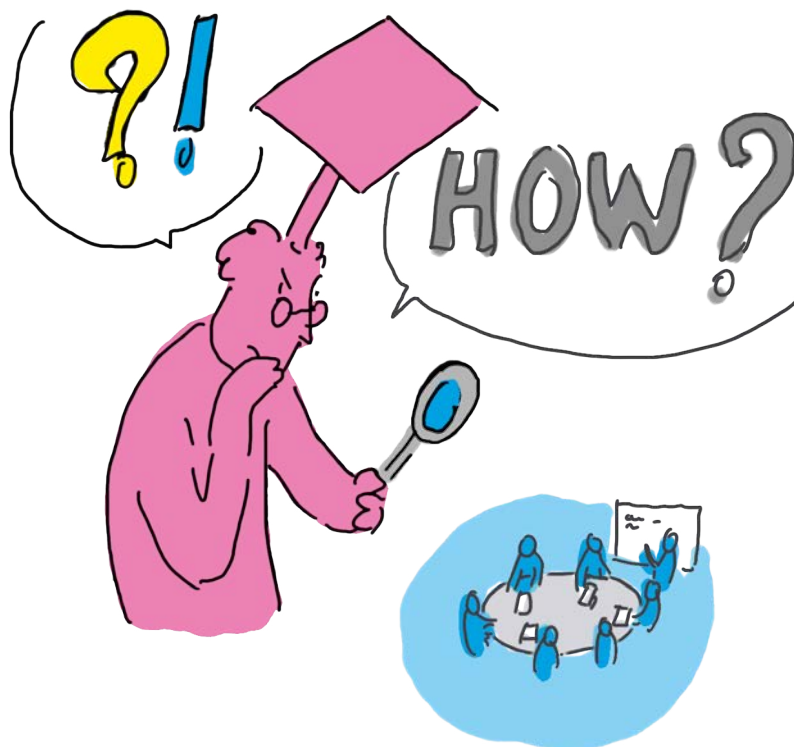
2.1 Adequately formulated Intended Learning Outcomes (ILOs)

It is necessary to define the learning objectives of every PBL unit precisely and fully ; these objectives are formulated as Intended Learning Outcomes (ILOs) ⊘ 3. In some cases, the ILOs will be given to the students; more advanced students will be asked to formulate the ILOs in the PBL process by themselves ⊘ 2.3, step 5

EXAMPLE OF ILO FORMULATION:

WHEN   WHAT   HOW? (LEVEL)

a) After PBL unit 2 of the Introductory Programming Course,
b) students will be able to describe the effects of the execution of a short Python program
c) not seen previously and no longer than 60 lines of code, without executing the program and without access to resources
d) expected performance:
   • every presented effect is described fully and correctly, using the appropriate technical language
   • no effect is omitted
   • effects produced by specific input values are indicated
   • error conditions are indicated

UNDER WHICH CONDITIONS?

WHEN
a) the moment in time when the capabilities described in item b)of the ILO should be achieved

WHAT
b) the behavior expected from students, specified by means of an action verb applied to specific contents

A precise formulation of ILOs necessarily includes the following elements:
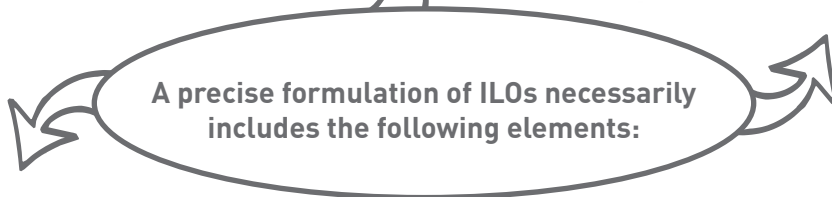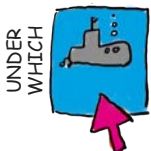
CONDITIONS?
UNDER WHICH
c) the context, the conditions, the situations in which the behavior described in item b] is expected

HOW? (LEVEL)
d) the expected performance level

2.2 A motivating situation / problem statement

THE SITUATION SHOULD FOCUS ON **LEARNING** RATHER THAN ON PRACTICING

Situation for **learning**

=

Situation for **practicing**

=

apply procedures in order
to achieve proficiency

scenario

=

context + mission in order to achieve ILOs

Students apply known concepts,
principles, methods, procedures
in order to **consolidate** previous
learning.

Students are led to acquire **new**
knowledge and competences
while building upon previous
learning.

EXAMPLE

A small car and a big truck are
driving at high speed on a road.
An obstruction appears, both
drivers start braking at the same
time; which VEHICLE will stop
first? Your physics book
can help ....

In PBL, the key element is motivating students to learn (create the **need to learn**). The learning situation or problem must be stimulating in order for students to engage in the process. In lecture-oriented pedagogy, a good lecturer will present information and stimulate students' interest for the subject matter, whereas in PBL it is the problem statement / situation which needs to truly engage students.

More about the qualities of a "good" problem statement / situation ⊘ 6

2.3 A three-phase process

A typical work sequence for students in PBL is composed of 3 phases, each of them is it-self composed of a number of steps. In the approach introduced in 1976 by Henk Schmidt, there was a total of 7 steps (or "jumps") and by the 80's this model became well estab-lis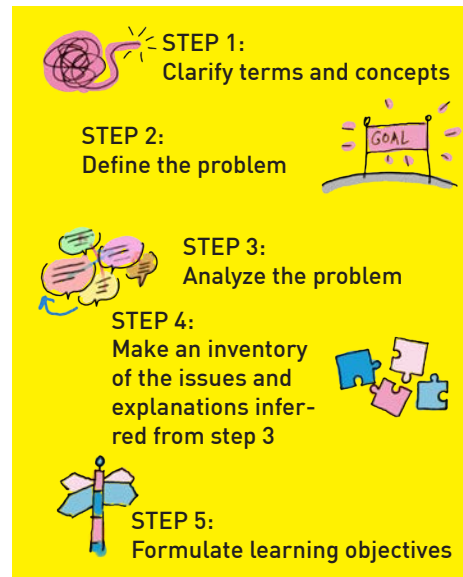hed at U. Maastricht and several other institutions (Servant-Miklos, 2019). The number of phases and steps have changed over time in institutions using PBL in order to be tailored to various disciplines and learning objectives. ⊘ 4

The original PBL standard: three phases w

1ST TUTORIAL

AUTONOMOUS WORK

The purpose of the first tutorial is to ensure that the group members (1) are attuned w.r.t. their interpre-tation of the problem, (2) agree upon which elements in the problem need to be explained, (3) recapitulate their opinions, thoughts, ideas and prior knowledge on the problem, (4) make an inventory of the explanations inferred from step no 3 and (5) clarify what to learn and what to produce during the autonomous work.

STEP 1:
Clarify terms and concepts

STEP 2:
Define the problem

STEP 3:
Analyze the problem

STEP 4:
Make an inventory of the issues and explanations infer-red from step 3

STEP 5:
Formulate learning objectives

STEP 6:
Collect additional information outside the group : students are expected to make use of books and other reliable resources to tackle the problem

In the PBL approach, self-directed learning is supported by group work...

This sequence is iterated multiple times during a semester. The process for a single PBL unit takes between 1 and 2 weeks; each tutorial lasts about 1 to 2 hours, and the autonomous work requires between 8 to 20 hours of student work.

ith a total of 7 steps

2ND TUTORIAL

Students share what they've learned and collectively produce solutions or explanations to the original problem.

STEP 7:
Synthesize and check the newly acquired knowledge

Well, some steps are missing here: we usually start with a step 0: define the roles within the group

Hmm, the seven-jump is not sufficient...

In my PBL, I focus on reflecting about learnings and results: I add yet another step

A more general model is presented in ⟩ 4

2.4 Information for students

We find it useful to provide all the information needed by students in a handy booklet, which contains:
- the problem statement with expected deliverables
- the Intended Learning Outcomes (ILOs) to be achieved by means of the PBL unit (if not to be defined by the students themselves)
- a summary of each step of the PBL process and the role students will have to complete
- a timetable of the activities
- a list of necessary / useful resources
- a list of self-assessment questions to help students measure their progress toward the ILOs

TWO IMPORTANT QUESTIONS

Should the ILOs be given to students or not?

- Giving ILOs to students guides them towards the intended objectives

- Not giving the ILO to the students forces them to discover them…

**Should we provide all the resources needed to understand and solve the problem or not?**

- Giving the resources allows students to be more efficient in their reading and to spend less time searching for relevant information.

- On the other hand, if one of the learning objectives is to identify relevant information, finding the resources becomes the students' **own responsibility**

Soucisse et al. (2003) found that 1st year undergraduate students preferred that the resources were given to them and that, later on, students preferred searching for resources by themselves. 1st year students tend to be somewhat destabilized by the approach and, at this point, they may not feel confident about their capability to find all relevant information. Furthermore, searching the literature is time-consuming and students may limit themselves to just gathering information rather than exploiting it; this often leads to poor discussions during phase 3.

2.5 **Information for tutors**

The tutor manual aims to prepare tutors for their role. It contains:
- all the information given to the students
- additional explanatory information (not given to the students) ⊘ 8.4
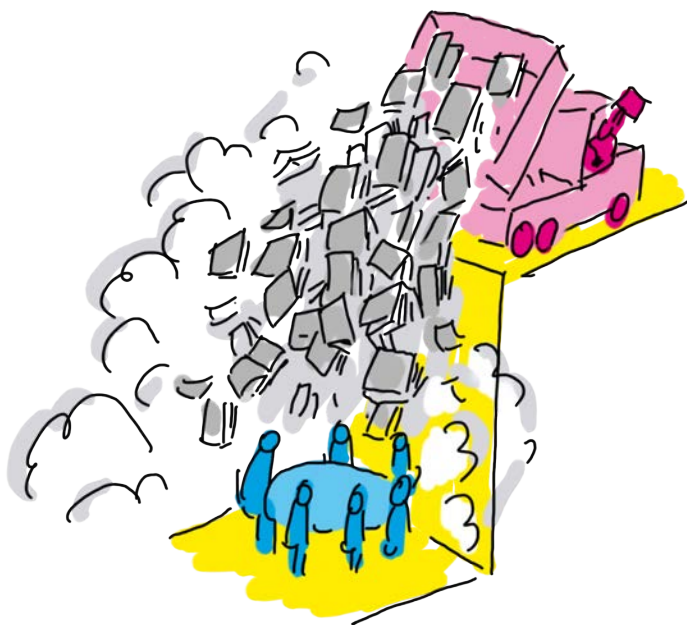
The instructions said:
to prepare yourselves
for the PBL unit, consult
the books in the library

2.6 Assessment of students' learning

The assessment of the learning achieved by students should be aligned with the learning objectives (ILOs) and with learning activities ⊘ **3.2**. This means that:

- the assessment process should evaluate the achievement of all ILOs in the 4 possible domains of learning: cognitive, affective, psychomotor, and reflexive ⊘ (Bloom 1956)
- The learning activities should prepare students for the assessment processes.

Preparation for assessment:

One important role for the tutor is to encourage student self-reflective practices and give students feedback about their learning ⊘ **7.2**. For that purpose, the booklet usually contains a list of self-assessment questions to help students measure their progress toward the ILOs ⊘ **2.4**. Some institutions propose summative assessment at the end of the PBL process ⊘ **4.6**.

This means that the preparation for the assessment is included in the PBL process.

From my exchanges with students, if I find out what they don't understand; I can adapt my actions to improve their understanding.
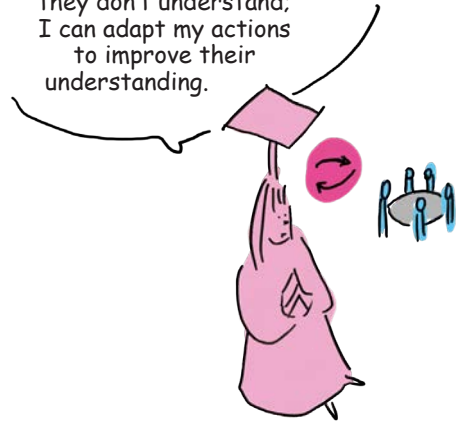
It's difficult to get involved in group work when my performance is assessed individually.
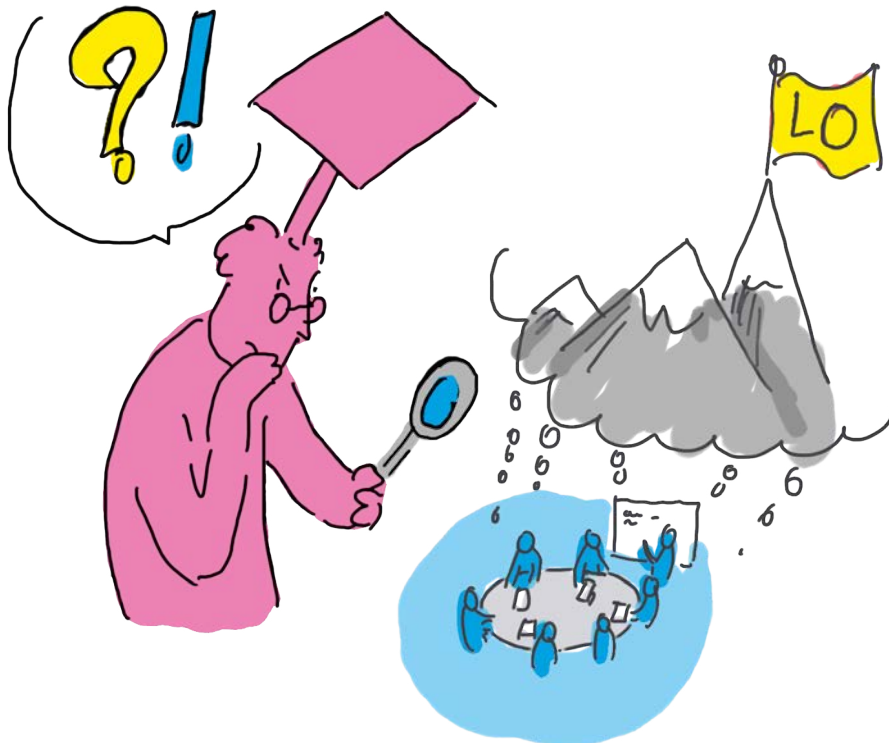
Final summative assessment:

The final assessment must be individual as each student must demonstrate that he/she has achieved all the ILOs at a sufficient level of performance.

If, however, the assessment pertains to the quality of the group's work, then a group assessment is needed.

3

What are learning outcomes? What kind of learning outcomes is PBL best suited for?

3.1 What are Intended Learning Outcomes?

Every learning activity proposed to students aims to enable students to progress towards achieving specific objectives. We expect these objectives to be formulated as Intended Learning Outcomes (ILOs). "Intended" because these are the objectives that teachers aim for. Made up of specific kinds of learning activities, PBL units aim to enable students to progress towards specific ILOs.
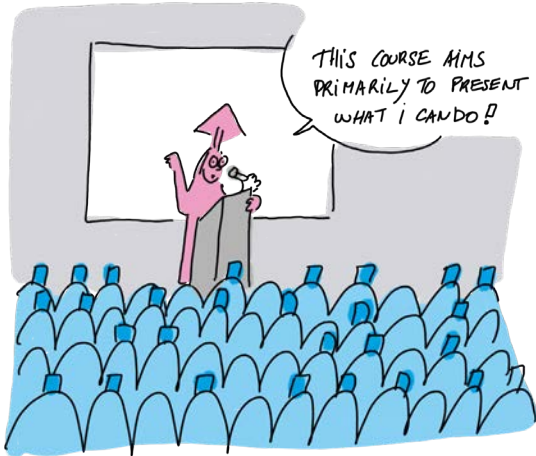
Characteristics of Intended Learning Outcomesof learning activities

- **they are centered on the learners, i.e., the students**
- **they describe what the learners should be able to do after completion of the learning activities: they describe actions, not states**
- **they describe what is certified after the successful completion of learning activities and their corresponding assessment processes**

EXAMPLES

After having completed the 3rd PBL unit in an introductory physics course, students will be able to:
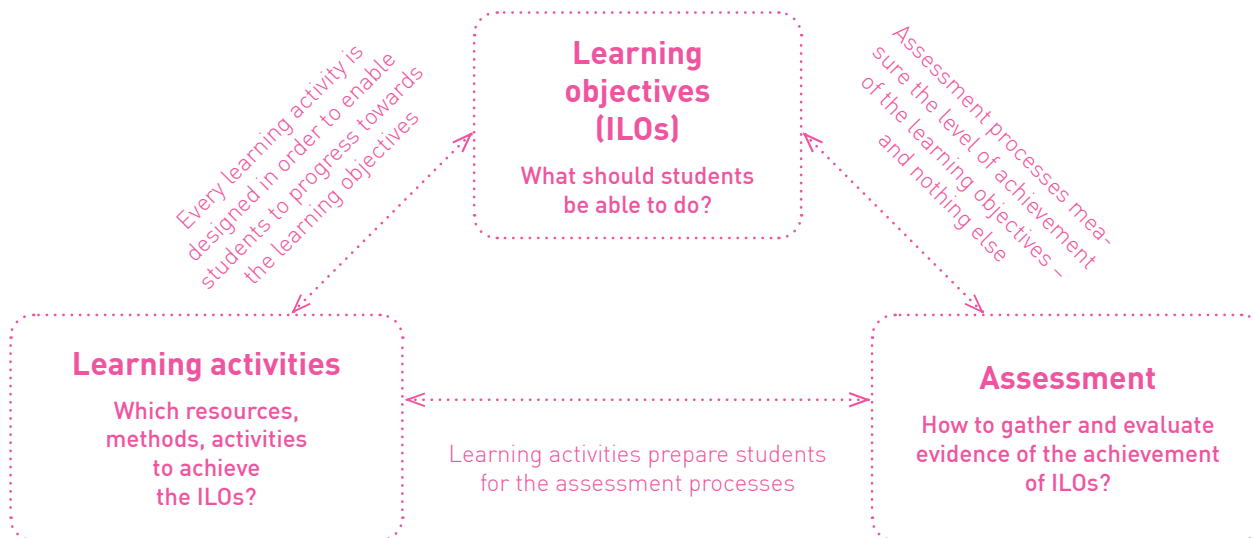- write the Euler equation and define each of its terms
- produce the free-body analysis of a simple static case (draw the forces, speeds and accelerations)
- describe the theory of universal gravitation and explain the motion of planets
- describe the motion of a ball along a 2D circuit
- …

3.2 **What is pedagogical alignment and why is it essential in instructional design?**

The three components of every teaching/learning system are:
• the targeted learning objectives (Intended Learning Outcomes – ILOs)
• the teaching and learning activities
• the assessment and feedback mechanisms

PEDAGOGICAL ALIGNMENT REQUIRES THAT SPECIFIC RELATIONS
NEED TO HOLD BETWEEN THESE THREE COMPONENTS:

Every learning activity is designed in order to enable students to progress towards the learning objectives

Learning objectives (ILOs)

What should students be able to do?

Assessment processes measure the level of achievement of the learning objectives – and nothing else

Learning activities

Which resources, methods, activities to achieve the ILOs?

Learning activities prepare students for the assessment processes

Assessment

How to gather and evaluate evidence of the achievement of ILOs?

⚠ **Pedagogical alignment yields the following contract between teachers and students:**

<u>If</u> students execute the learning activities conscientiously,
<u>then</u> teachers guarantee that students will achieve the learning objectives
<u>and</u> that they will be able to provide evidence thereof by successfully passing the assessment processes.

3.3 Why is reflexive thinking essential in deep learning?

Learning is central among the goals pursued by (higher) education. Surprisingly enough, little attention is usually devoted to making learning processes explicit – be it for teachers or for students. It is almost as if learning is self-evident and thus needs not overly concern us! Since we all know that humans (need to) learn throughout their entire (professional and "regular") lives, it is not too farfetched to claim that higher education (HE) should prepare students for lifelong learning. In other words: proficiency in learning should be an explicit objective of any HE program.

This raises the following question:
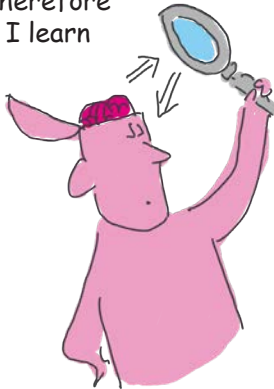- **how does one learn to learn?**

or, more precisely:
- **how does one analyze the quality of one's own learning?**

and
- **how does one improve the quality of one's learning when it needs to be?**

I think,
therefore
I learn

Reflexivity (with respect to learning) is the capability to answer both these questions satisfactorily.

Along with the three usual domains of learning outcomes (cognitive, affective, and psychomotor), we include a fourth domain: the **reflexive** or **metacognitive** domain.

ILOs relating to learning to learn should explicitly appear in the list of learning outcomes of any HE program, and sufficient learning activities should be included to enable students to achieve those ILOs and provide evidence of these achievements.

The way to develop reflexivity among students is certainly not by including a course on reflexivity in the curriculum!
The best way to achieve reflexivity ILOs is by **providing opportunities for reflexive thinking** in regular learning activities, with feedback provided by teachers. The PBL process provides several such opportunities, to be guided by the tutor.

3.4 **Why are ILOs, pedagogical alignment, and reflexivity important in PBL?**

For students who have been previously educated in mostly transmissive (teacher-centered) pedagogy, accepting to engage in PBL, which is active, cooperative, situated learning in small groups ⊘ 1 is not self-evident: some (or a lot of) resistance is to be expected with respect to such a significant change in teaching/learning philosophy.

Convincing students to accept PBL as a valid (i.e. efficient) pedagogy is a real challenge. Surprisingly enough (or not), most students will not accept teachers' statements about how great PBL is or stories about how wonderfully it worked in far away places at face value: it is essential that students experience themselves that PBL works for them.

It is therefore very important that the first PBL experience(s) students will encounter are fully successful in this respect: they need thus to be prepared and implemented with great care in order to convince students of the validity and usefulness of the method ⊘ 8.

How does one convince students that PBL works for them? At the most primitive level, students must trust that engaging in the PBL processes proposed by their teachers will truly help them achieve the ILOs (and get good grades?) Pedagogical alignment – and the contract it implies between teachers and students – is a powerful element to convince students that PBL works, provided that the various problem statements / situations proposed to students and the PBL process really lead students (who do the work seriously) to achieve the Intended Learning Outcomes and therefore successfully pass the examinations.

Reflexivity adds a layer to the argumentation in favor of PBL by making the learning process explicit and by helping students improve their own learning methods.
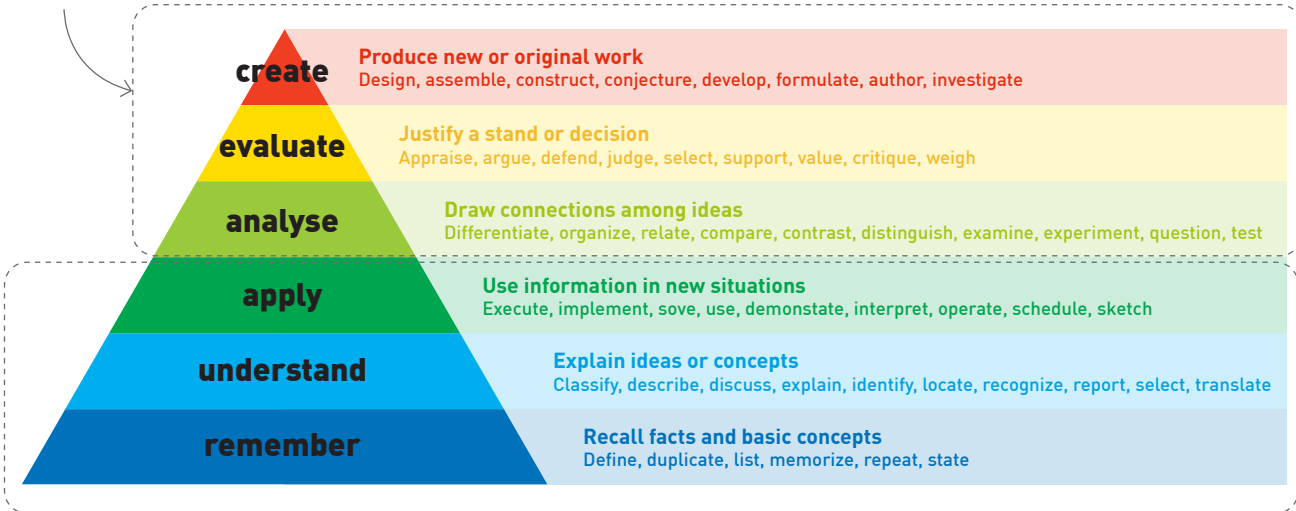
Reflexivity
is important...
Believe me...

Talk, talk,
and
yet more
talk!
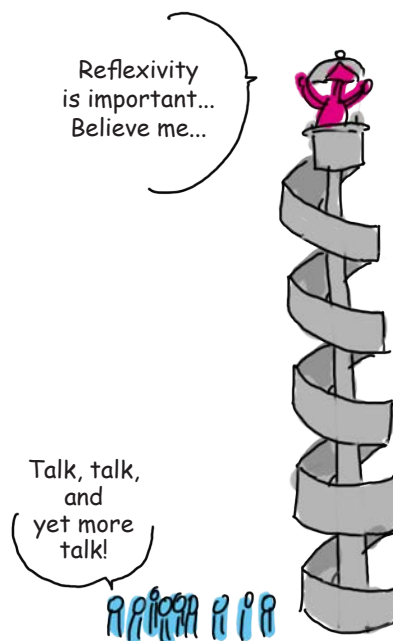
3.5 Which types of ILOs can be achieved by means of PBL?

COGNITIVE DOMAIN

☑ *The higher levels of Bloom's taxonomy for the cognitive domain can be achieved by means of PBL*

create
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

evaluate
Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh

analyse
Draw connections among ideas
Differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

apply
Use information in new situations
Execute, implement, sove, use, demonstate, interpret, operate, schedule, sketch

understand
Explain ideas or concepts
Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

remember
Recall facts and basic concepts
Define, duplicate, list, memorize, repeat, state

I only learn in the cognitive domain; I don't care about the other ones !

☒ *Lectures and in general teacher-centered methods are suitable mostly for the first three levels but struggle to reach the upper half whereas PBL encompasses all levels.*

Krathwohl & Bloom's Affective Taxonomy

WHAT IS THE AFFECTIVE DOMAIN?
Includes behaviors indicating attitudes, awareness, attention, concern, interest, and responsability. Often assessed by ability to listen and respond in the environment and by the attitudes and values appropriate for the field of study.

Does the student act consistently with the new value?
Concerned with
PATTERNS OF ADJUSTMENT
Act, Discriminate, Display, Influence, Internalize, Listen, Modify, Perform, Practice, Propose, Qualify, Question, Revise, Serve, Solve, Use, Verify

Does the student show involvement & commitment?
Concerned with
ATTITUDES & APPRECIATION
Accept, Complete, Defend, Describe, Devote, Differentiate, Explain, Follow, Form, Initiate, Invite, Join, Justify, Propose, Puruse, Read, Report, Seek, Select, Share, Study, Work

Is the student aware of or responding to the environment?
Concerned with
SIMPLE AWARENESS & SELECTIVE ATTENTION
Accept, Ask, Attend, Choose, Describe, Develop, Follow, Give, Hold, Identify, Locate, Name, Point to, Recognize, Select, Sit Erect, Reply, Use

CHARACTERIZE

ORGANIZE

VALUE

RESPOND

RECEIVE / ATTEND

Has the student combined and conceptualized a new value giving it priority?
Concerned with
PHILOSOPHY OF LIFE
Adhere, Alter, Arrange, Codify, Combine, Compare, Defend, Discriminate, Display, Explain, Generalize, Identify, Integrate, Modify, Order, Organize, Prepare, Relate, Systemize, Weigh

Can the student show a new behavior due to an experience?
Concerned with
INTEREST, SEEKING & ENJOYMENT
Answer, Assist, Complete, Comply, Conform, Cooperate, Discuss, Examine, Greet, Help, Label, Obey, Perform, Practice, Present, Read, Recite, Report, Respond, Select, Tell, Write

ILOS of the Affective domain: communication (speaking and listening), efficient teamwork, conflict resolution, leadership, ...

3.6 How is reflexivity exercised during the PBL tutorials?

DURING THE 1ST TUTORIAL

Guided by the tutor and supported by the interactions with the other team members, students are led to:
- identify what they know and what they don't know
- identify links to previous learnings
- list what they understand and what they don't
- formulate hypotheses
- formulate possible approaches to tackle the situation
- formulate questions to be answered
- formulate possible approaches to acquire necessary knowledge
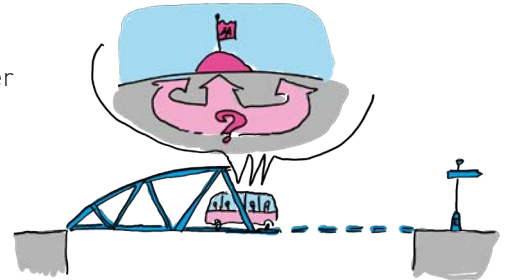
DURING THE 2ND TUTORIAL

Guided by the tutor and supported by the interactions with the other team members, students are led to:
- identify what they understood and what they failed to understand during the autonomous phase
- reflect upon the difficulties encountered during the learning process
- reflect upon the difficulties encountered in teamwork
- formulate approaches to overcome similar difficulties in the future
- formulate resolutions for improvement
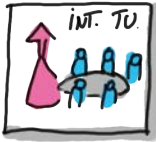- assess the success (or the failure) of previous resolutions
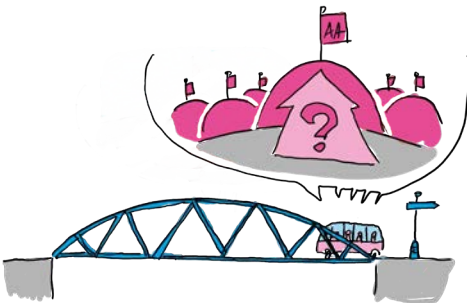
4

A general model for PBL:
# multiple phases and steps
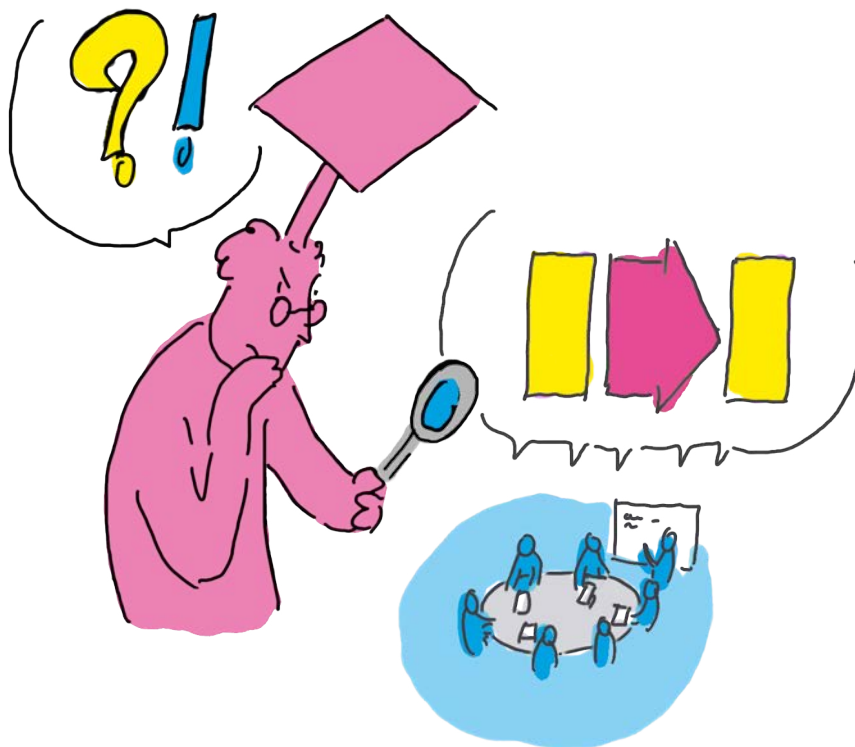
PBL COMPONENTS

Intermediary tutorial (optional)

In some cases, it may be necessary to ascertain that the autonomous work proceeds as expected and to tackle specific difficulties which arise before the 2nd tutorial. This may be the case with students not yet fully familiar with the PBL method or when the learning to be achieved during the autonomous work phase could lead some students astray.

The objective of the optional intermediary tutorial is to clarify potential difficulties and, if necessary, to re-vise the work plan to take them into account. It may also be used to (re)motivate students during the autonomous work phase.

> 4.3
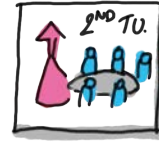
Second tutorial

The objective pursued by the 2nd tutorial is to ascertain that the expected learning goals have been achieved, to propose an-swers to all questions raised during the 1st tutorial and during the autonomous work, and to draw lessons from the work that has been done.

> 4.4

First tutorial

The objective pursued by the 1st tutorial is to collectively construct a work plan for the upcoming autonomous work phase and to ensure that every student knows what he/she will have to do.
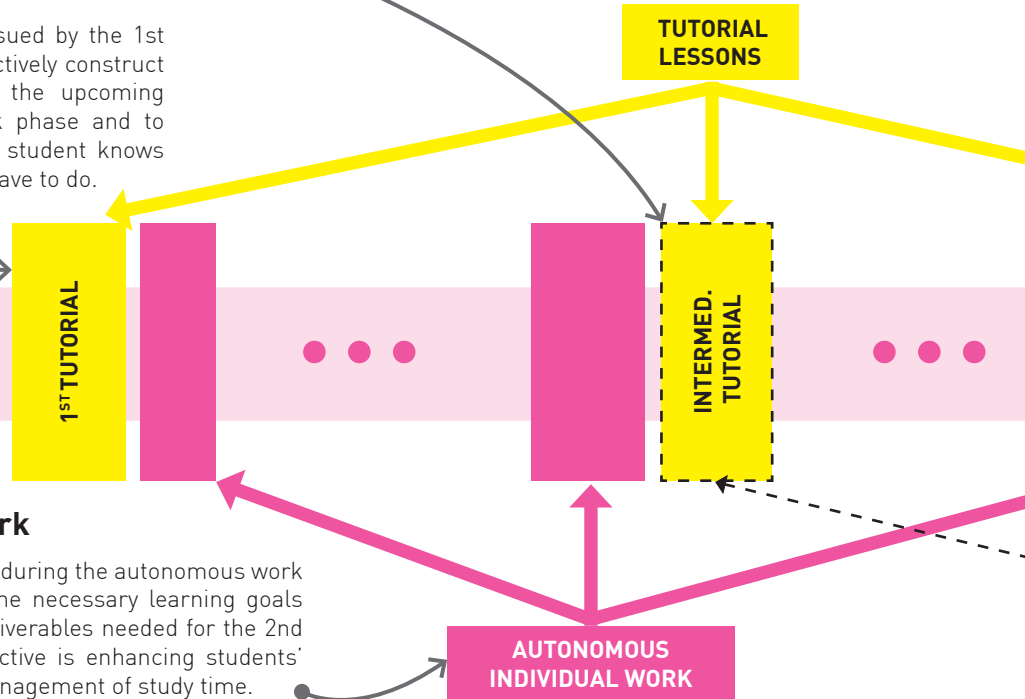
> 4.1

TUTORIAL LESSONS

1ST TUTORIAL

INTERMED. TUTORIAL

Autonomous work

The objective pursued during the autonomous work phase is to achieve the necessary learning goals and to produce all deliverables needed for the 2nd tutorial. Another objective is enhancing students' competence in the management of study time.

> 4.2

AUTONOMOUS INDIVIDUAL WORK

AND THEIR OBJECTIVES

Pooling and comparison phase (optional)

The objective of the pooling and comparison phase is to expose students to differences in viewpoints, in formulations, in answers to encourage them to accepts that there are many acceptable ways to tackle a problem. This can be organized when several teams meet in the same room.
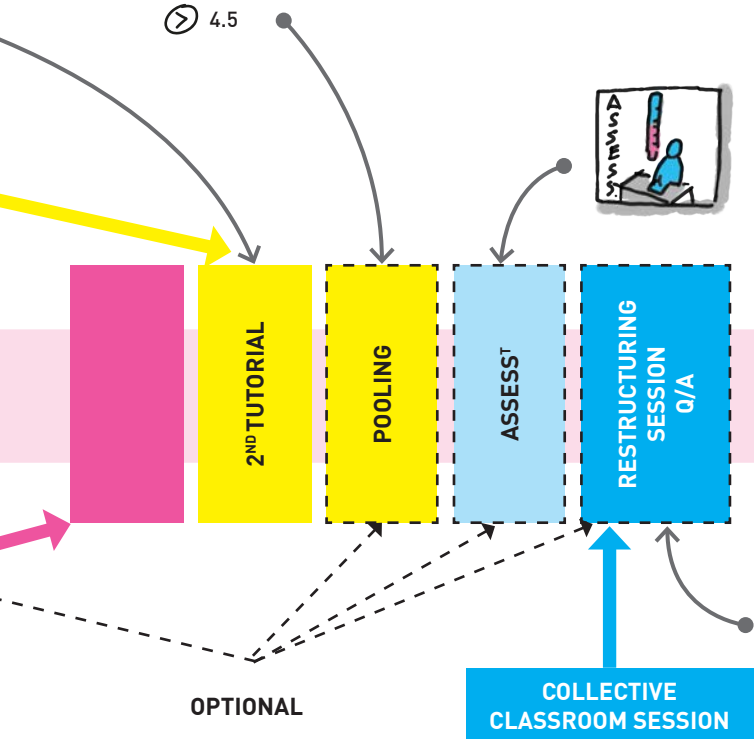
⊙ 4.5
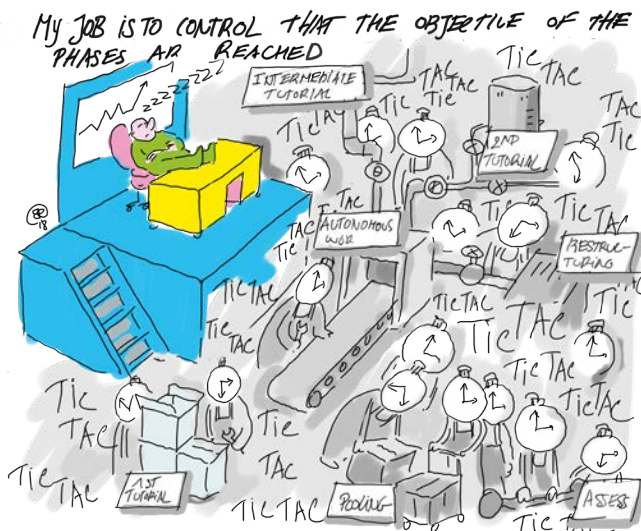
Summative assessment (optional)

Summative assessment at the end of a PBL process aims at proving to students that doing the job conscientiously will indeed lead to achieving the intended learning outcomes.

⊙ 4.6

2ND TUTORIAL
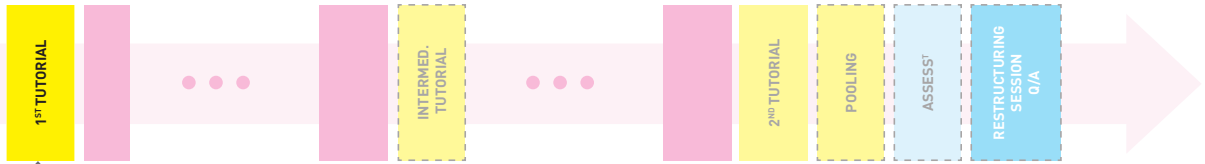
POOLING

ASSESSᵀ

RESTRUCTURING SESSION Q/A

Restructuring session (optional)

The objectives of the optional restructuring session are

• to have the class collectively provide its best answers to remaining issues and questions
• to allow the teacher to provide additional insights to the course material.

⊙ 4.7

OPTIONAL

COLLECTIVE CLASSROOM SESSION

4.1 First tutorial

The 1st tutorial consists of a number of steps, among which:
- organize the team and assign roles to team members
- analyze and discuss the problem statement and ensure everyone has a common understanding of the problem
- identify the questions that need to be answered
- identify potential approaches to answers/solutions through brainstorming
- formulate learning outcomes to be acquired in order to fill the gaps in available knowledge
- indicate which deliverables are expected for the 2nd tutorial
- formulate a work plan for the autonomous work phase.

I see a lot of dynamism, but also a lot of questions in different directions.
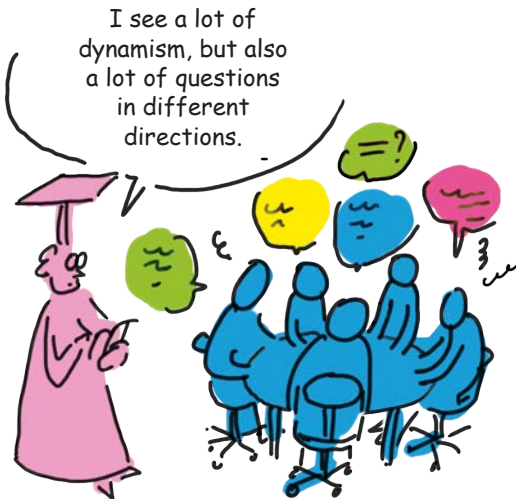
Before the end of the 1st tutorial, the tutor ascertains that the learning outcomes, the list of questions to be answered, the work plan, and the expected deliverables (if any) are clear to all students.

≪ *During the 1st tutorial, we have lots of discussions to clarify what we need to learn and do. There are many different opinions, and we work hard towards reaching agreement among ourselves…* ≫
(a student)
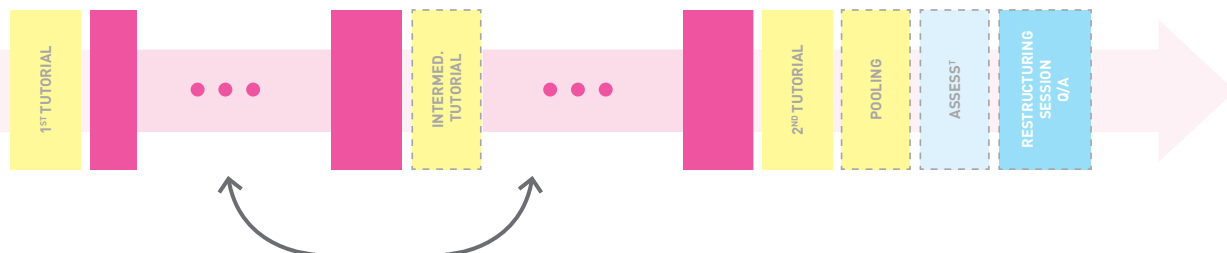
4.2 **Autonomous work**

Every student executes the agreed-upon work plan, which requires new learning in order to achieve the identified learning outcomes and prepare deliverables for the 2nd tutorial session, including proposals for answers to the questions raised and recorded during the 1st tutorial.
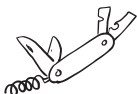
During the autonomous work phase, team meetings (without a tutor) are discouraged, but contacts between students are allowed.
As often as possible, the designer(s) of the problem provide self-assessment tests to allow students to verify the adequacy of their learning.
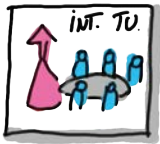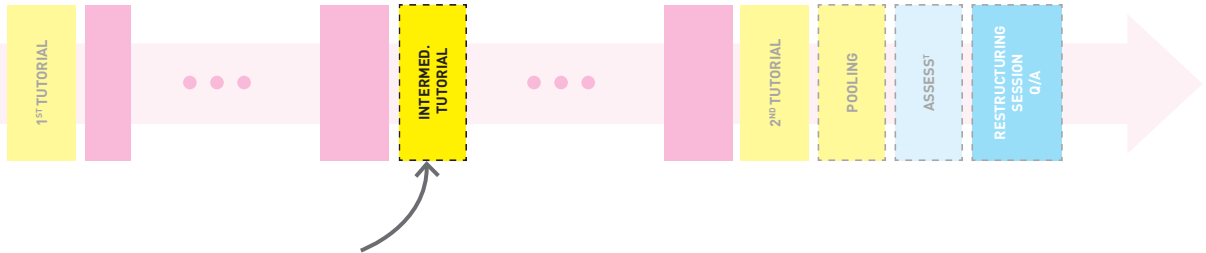
It's frustrating ...
They work without my precious help

I have nothing to do but wait for the 2nd tutorial

We study the material, and we do what we agreed upon during the 1st tutorial.
Sometimes we work with other team members, but most often we work alone…
(a student)

4.3 **Intermediary tutorial (optional)**

Based on their experience, the designer(s) of the problem may have identified potential pitfalls which could arise during the autonomous work phase. This may result in students either going down on entirely wrong tracks and/or losing motivation. An intermediate tutorial can then be programmed in order to take stock of the progress of team members and to tackle specific difficulties.
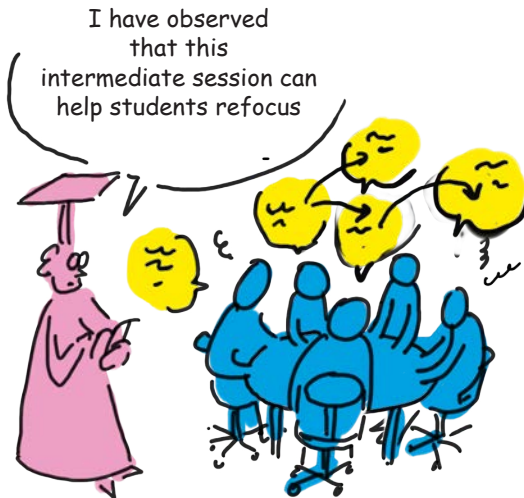
After the 1st tutorial, we were somewhat lost; the first part of our autonomous study has clarified things: now we think we know better what is expected from us…

(a student)

1ST TUTORIAL ··· INTERMED. TUTORIAL ··· 2ND TUTORIAL POOLING ASSESST RESTRUCTURING SESSION Q/A
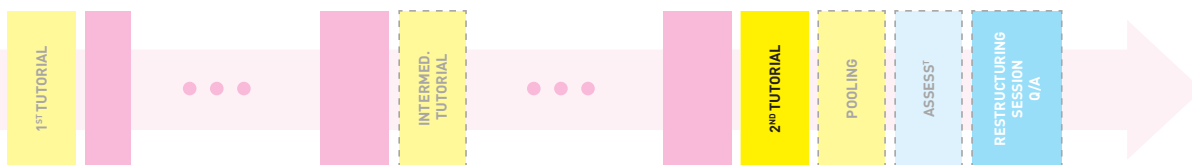
4.4 **Second tutorial**

The 2nd tutorial consists of a number of steps such as:

- comparing answers provided by team members to the questions raised during the 1st tutorial and select the ones to be retained
- providing evidence of achieved learning outcomes
- formulating solutions to the problem situation
- determining issues still to be resolved
- collectively identifying potential improvements to teamwork
- individually identifying potential improvements to individual work

I have observed that they all converge towards ILOs based on their individual contributions

At this point, students may be very much concerned with the "correct" or "expected" solution to the given problem. To reassure them, and because learning is the foremost objective of PBL, the tutor verifies during the 2nd tutorial that the learning outcomes have been achieved by all team members. The designer(s) of the problem may provide a list of questions to the tutor for that purpose.

We first listen to the contributions of all members and then we decide upon the solution…
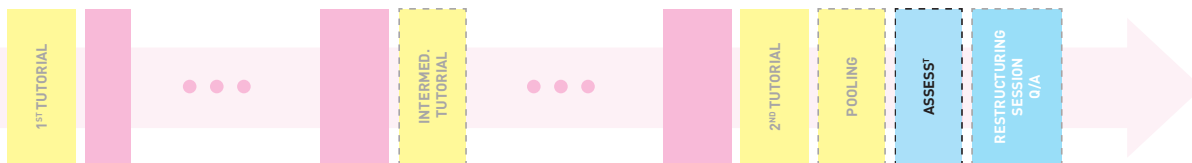
(a student)
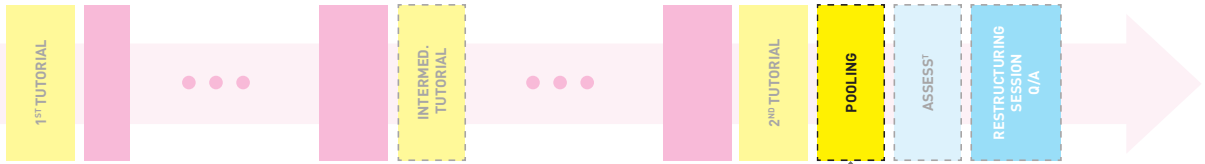
4.5 Pooling and comparison phase (optional)

After concluding the formal steps of the 2nd tutorial and even though this is not part of standard practice in PBL, when several teams meet in the same room, it can be very useful and enlightening to compare the answers and solutions provided by the various teams. This provides both an opportunity to discover different points of view and different ways to express them.

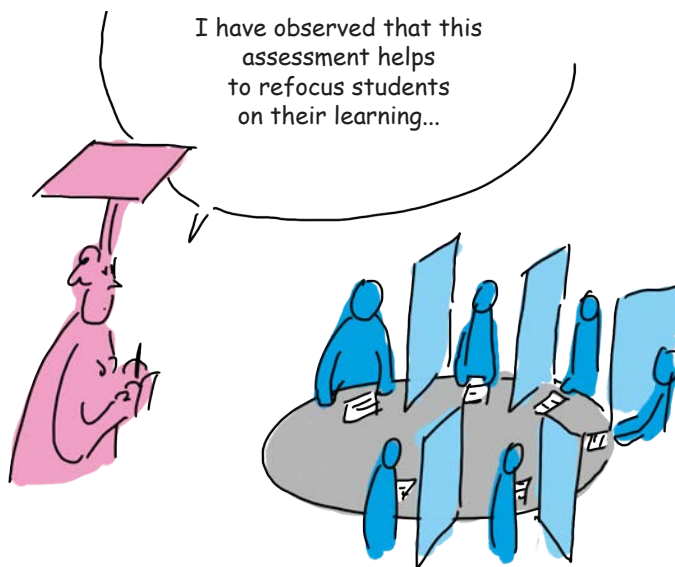I have observed that students like to talk about what they have achieved.
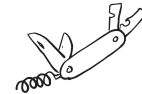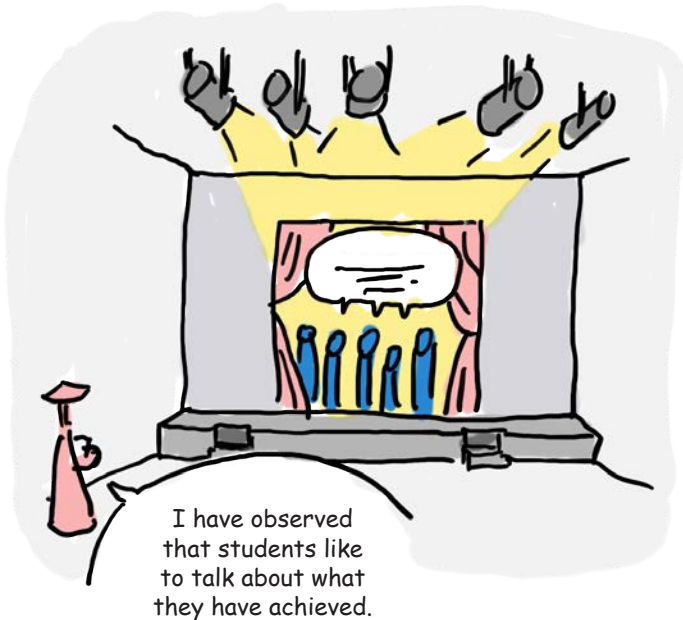
ALTERNATIVES:

• One team presents their solution, and all the other teams ask relevant questions.
• Teams are paired and, within each pair, every team present their solution to the other team who ask questions.
• The tutor asks a question from all the teams and each team provide their answers after a short preparation

4.6 **Summative assessment (optional)**

Some institutions explicitly program summative assessments after the completion of every PBL process in order to show students that active participation in all phases of the process really leads to achieving the intended learning outcomes and contributes to reaching the goals of the course (and thus to final success).

I have observed that this assessment helps to refocus students on their learning...

1ST TUTORIAL · · · INTERMED. TUTORIAL · · · 2ND TUTORIAL POOLING ASSESS' **RESTRUCTURING SESSION Q/A**
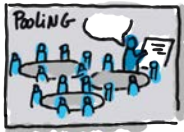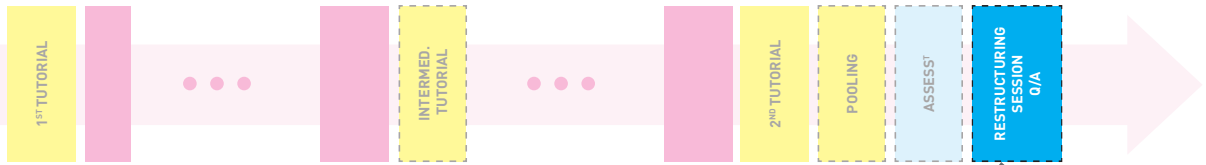
4.7 Restructuring session (optional)

It is often the case that tutors report difficulties that arose during the PBL process: common misunderstandings, common errors, issues which were overlooked, missing answers, obstacles to learning, etc.

I have observed that my students are more active when the discussion is initiated starting from their own questions...
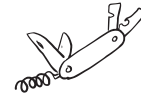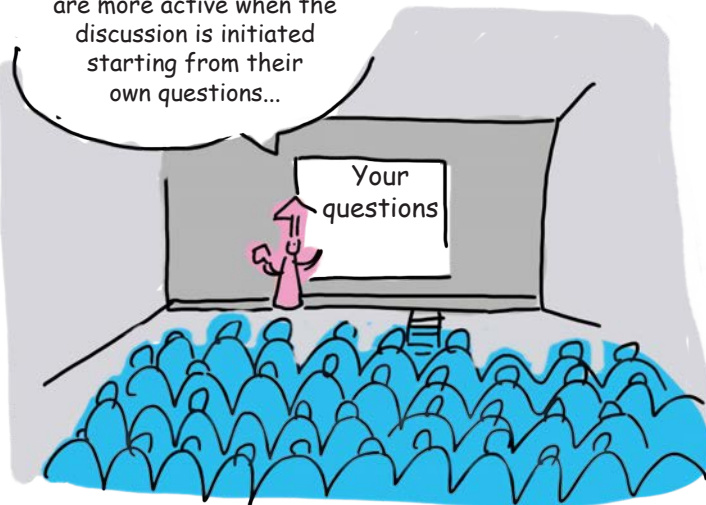
Your questions

Questions may be transmitted by tutors, deposited on the LMS, sent by e-mail or even written on Post-Its™ stuck to the door of the team meeting room...

5

Who is who and who does what in PBL?

5.1 What new roles for students?

ACTIVE LEARNERS
who **direct** classroom practices
⊘ 1.2
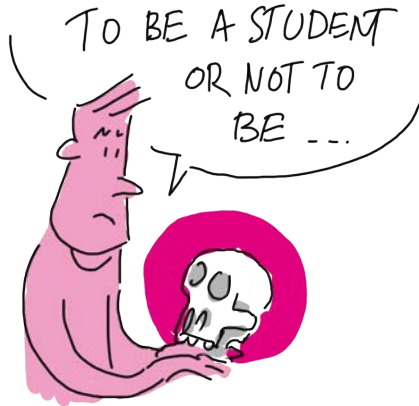
With its student-centred, active, cooperative, contextualized learning approach and tutored small-group group format, PBL **redefines the roles** of all educational stakeholders and requires them to acquire and master a new, **different set of skills**.

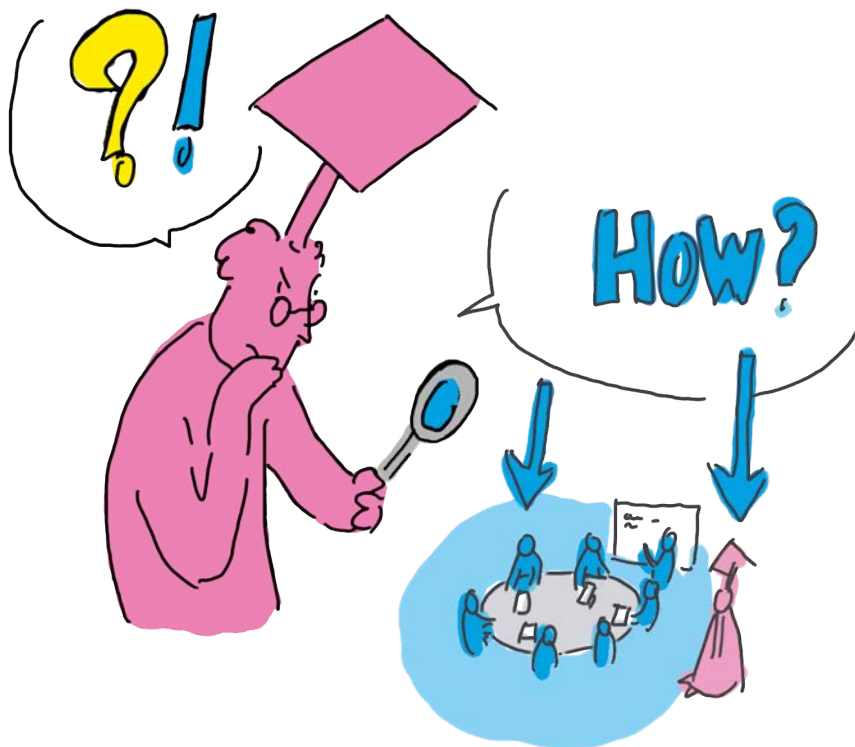This also means that the efficacy and success of a PBL curriculum might come down to preparing stakeholders – students, groups of students, tutors, curriculum creators, experts, and course coordinators – for these new educational roles, most notably by setting up carefully conceived **training modules which prepare them for their new roles and provide them with the necessary skills.**

⊘ 8.7

COLLABORATIVE LEARNERS
who know how to contribute to and take advantage of teamwork
⊘ 1.3

CONSCIOUS LEARNERS

who understand, use, and even more importantly, who reflect on learning practices.
Students need to master:

- the basic PBL process, its phases and their steps
  ⊘ 4
- the typical roles within a group
  ⊘ 8.3
- reflexive practices
  ⊘ 3.3

Being a conscious learner involves not only studying the subject matter, but also learning to learn efficiently.

Consequently, to improve the efficacy and the quality of their learning experience, students are induced to reflect on:

- their own practices within the class or meeting room
- their own practices outside the class or meeting room, during autonomous work
- the curriculum itself

AUTONOMOUS LEARNERS

able to:

- conduct self-directed learning in an autonomous fashion
- filter and synthesize infor-mation for the group
- set their own personal learning and self-develop-ment goals

It is called
" autonomous "
learning, but all the
steps are
compulsory!

5.2 What new roles for the group?

IN PBL, THE GROUP:

- decides together on classroom roles ⊘ 8.3
- brainstorms about and shares previous knowledge
- analyzes problems
- sets learning goals
- reflects together on whether learning goals were achieved
- reflects together on their learning practices
- reflects together on group dynamics

⚠ To optimize group dynamics, it is recommended to :

- organize ice breaking activities, team-building activities, and communicational training
- keep the group size between 5 and 8 students
- choose an adequate make-up of groups (complementarity of personalities and skill sets)
- Re-arrange the learning environment (round tables, shared screens, whiteboards, paper boards, ...)
⊘ 8.1, 8.2

≪ *If one of the Learning outcomes is the capability to handle conflicts in a group, put them in a large group (more than 12).* ≫

≪ *To have a true debate between students, it is necessary to have a group of at least 6; below this number, a consensus is reached too quickly.* ≫

THREE COMMON TYPES OF GROUP BEHAVIOR

The task-focused group

The group concentrates on collectively achieving the required learning outcomes: the group organizes itself in the most efficient way to produce the deliverables with the least possible effort.

As a result:
- the tasks are distributed among the members
- everyone does what he/she knows to do best
- students remain in their proximal zone of development (comfort zone)

Learning is minimal

The honeymoon group

The focus is on maintaining a positive group climate; the group believes that it is essential to preserve a good atmosphere in the group at all cost.

As a result:
- divergent points of view are avoided
- focus is maintained on what everyone agrees upon

Learning is low

The learning group

The group focus is on the learning process and on how to optimize its efficacy.

As a result:
- the group members try to achieve the same learning outcomes, **together**
- the group openly discusses controversial issues
- group discussions are aimed at enhancing the learning process for all

Learning is maximal

5.3 What's the tutor's role?
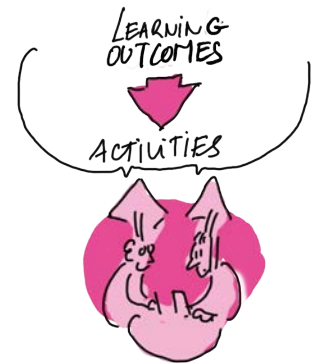
IN THE CLASSROOM

Tutors:

- observe students
- spot issues in learning practices, methodology, classroom behaviors and group dynamics
- ask the right questions to guide students towards learning outcomes
- facilitate students' self-assessment and feedback sessions.
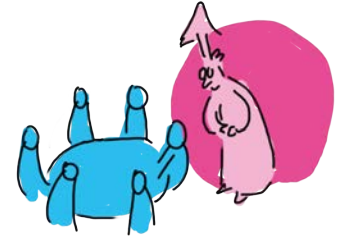
OUTSIDE THE CLASSROOM

Tutors:

- share feedback on the curriculum with curriculum creators based on the tutor's observations and student feedback
- reflect on their own classroom experience and share it with other tutors and with the PBL unit creators
- reflect on and learn from other tutors' classroom experience.

It is essential to understand that the tutor is not a teacher-expert, but a facilitator whose main role in the classroom is to guide students in order for them to achieve the learning goals and benefit from optimal group dynamics.
Compared to the traditional 'knowledge transmitter' role, this requires a more withheld, student-centered attitude.
However, this doesn't mean being passive – it just means adopting a different type of active stance.

For more information ⊘ 7

5.4 What's the expert's role?

To enhance students' knowledge acquisition, experts:

- provide students with additional resources
- share their expertise with students in the form of Q/A sessions
- participate in curriculum creation and assessment.

5.5 What's the role of PBL unit creators?

Every PBL unit needs to be carefully designed to ensure successful implementation and achievement of learning objectives.

PBL creators:

- define realistic (i.e.: achievable) Intended Learning Out-comes (ILOs) for every PBL unit
- design stimulating problem statements / situations
- identify necessary and optional resources both for students and for tutors ⊘ 2.4
- prepare the documents for students ⊘ 2.4 and for tutors ⊘ 2.5
- elicit feedback from tutors and from students to improve the PBL units.

5.6 Other roles:

What do curriculum creators do?

Ideally, the whole curriculum is created by an interdisciplinary team, with members possessing complementary skills, such as disciplinary knowledge and pedagogical know-how.
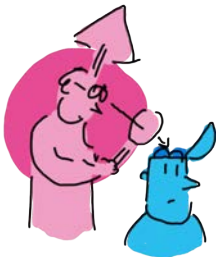
Curriculum creators:

- define the learning objectives (ILOs) of the curriculum
- map the whole of the curriculum (semesters and courses)
- define the role of the PBL units within the curriculum
- set learning outcomes for each PBL unit based on their understanding of the curriculum
- Hand over and explain PBL units to coordinators
- verify that all PBL units allow students to reach their ILOs

What's the role of learning assessors?

Pedagogical alignment is even more essential in PBL than in other pedagogical methods in order to convince students of its usefulness and efficiency ⊘ **3.2**. The alignment of assessments with ILOs and with learning activities must be evident for all students.

Learning assessors:

- define evaluation criteria derived from the stated ILOs
- create and implement an evaluation form (rubric) from the corresponding criteria and make this available to students and tutors
- create additional questionnaires both for tutors and students
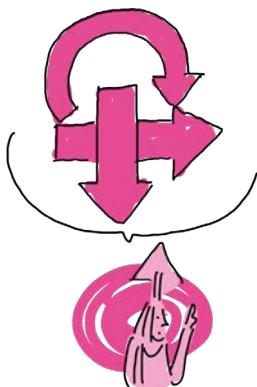
What's the role of course coordinators?

Ideally, course coordinators are members of the curriculum creator and assessment teams in order to have a global understanding of learning outcomes; it is recommended for them to tutor at least one student team to experience the curriculum in vivo.

Course coordinators:

- schedule classes after considering pedagogical outcomes and student needs
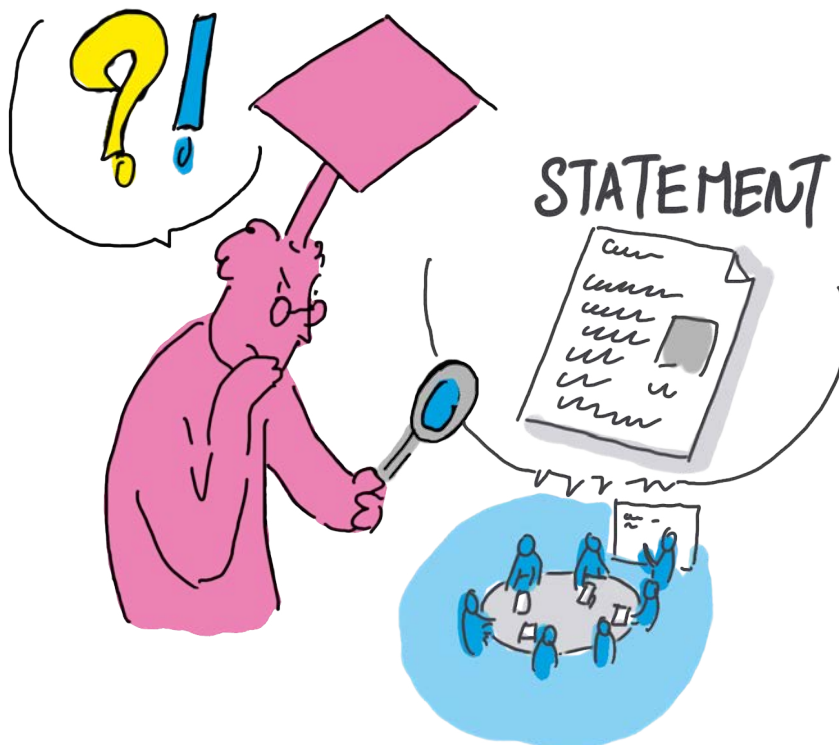- create sufficiently heterogeneous student teams
- train students in the PBL methodology (phases and steps)
- recruit a pool of tutors with the necessary competences
- train tutors (learning outcomes, PBL methodology)
- …

6

# Key elements for a good problem or learning statement / situation

6.1 Which objectives for the problem statement / situation?

The main objective of the problem statement is to motivate students' learning, i.e.: to trigger the **need to learn**. The challenge thus resides in making up a story:

- that leads to deep learning and reduces focus on the deliverables ⊘ **1.2**
- that takes into account the diversity of student profiles and their different centers of interest
- that gives enough information but not too much ⊘ **8.1**
- that takes into account the position of the PBL unit in the curriculum
- that engages all the team members and requires their collaboration

Why do they put us in groups? The problem is very simple: I want to solve it by myself, no big deal...
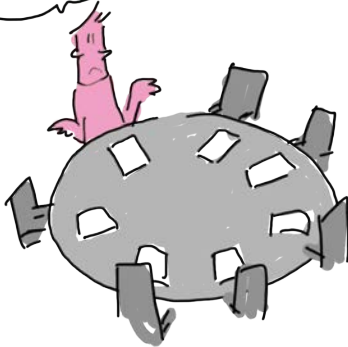
At the introductory level, problems are designed with many hints and with sharply focused content because novice learners require more structure and cues.
Later on, more advanced problems have fewer details and rely on more inferences since experienced students are better self-directed learners.

I write a problem that I like, I try to find tips to guide but without saying it, with riddles, false leads, reversals,...

When I read a problem, I look for the mission; sometimes, a long decoding work is needed to remove what is not essential for the resolution

The level of difficulty or complexity should be determined according to the students' assumed level of prior knowledge and to a workload they can fit in their global learning context.
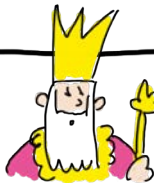
6.2 A counter-example: The King's Tale

No matter what outcomes the king set, this is what was achieved:

in an arid country, a small kingdom grew and prospered thanks to the magnificent vegetables produced in the meticulously irrigated gardens. The old king, feeling his strength weakening and death approaching, had to decide which one of his three sons should inherit the kingdom. Unable to choose, he puts them to the following test: he who produced the best vegetable soup would be his heir. The king secretly hoped that the test would incite his sons to learn the art of market gardening, the source of his kingdom's wealth.
Alas, the three princes, whose motivation lay exclusively in the perspective of becoming king, came in the night to steal the vegetables from the king's gardens. The king was hurt, and he summoned his ministers to a meeting: should the vegetables be given to the princes, or should the princes be kept in a locked space in which they could not avoid learning how to grow vegetables?

Individualism was encouraged as each prince had to accomplish the task on their own and this has created a competitive environment

No sense of responsibility was developed towards the inhabitants of the kingdom

The princes' attention was focused on becoming a king rather than on acquiring the required skills i.e., the princes' efforts were exclusively directed towards achieving the final goal.

The princes were given full autonomy which they turned out to be unprepared for.

Replacing the king by a teacher and the princes by students, we obtain the classical case we encounter when a problem is designed in an overly academic style. To avoid the pitfalls of the King's project, essential questions must be addressed:
- What are the goals of the problem?
- How can we guarantee that problem designers and students have a similar perception of the objectives?
- How will the statement encourage group work?

6.3 7 Keys for problem statements

Should the subject be a real problem or should it be more of an academic one? The first type is generally appreciated by students and is therefore intrinsically motivating. Adapting a real subject to fit in with academic/learning objectives would then seem to be the ideal compromise between students' motivation and a pragmatic definition of learning objectives to be reached in an inevitably limited time.

Real World

The situation ideally comes from the real world such as: how it relates to stuents' future profession or to their daily life. In other words: does this situation have value for them?

The topic should focus on learning and achieving the ILOs

Learning

The situation will lead to valuable learning objectives and added value in my training. This not a waste of my time.

Students' individual responsibility is engaged if the progression of their work on the problem is adequately planned and if the pre-requisites are adapted to their prior knowledge.

Achievable

The situation is achievable by all students : it must fall within their competence level. If it's too difficult, it's not worth trying, I cannot reach it, no can do.

7 KEY
A "GOOD" PROBI

Positive interdependence will be enhanced if the subject is complex enough to require genuine group work. However, the subject should not be so complex as to demotivate students, which would force the tutor to play a more important role than usually aimed for.

Collaboration

The situation requires collaboration among members of the group to achieve the task. It is not a one-man job.

Open subjects (the problem is incompletely defined; methods and tools are missing) give students more freedom : it is well known that this increases their motivation. On the other hand, in a closed subject (the problem is well-defined, the methods to be applied are known, even the expected solution may be known), students will mostly perform a succession of tasks without much room for initiative. The major advantages of a closed-subject are that learning objectives are easily controlled. Furthermore, well-defined objectives may lead to individual responsibility in the group if the tasks are well defined (in advance). However, responsibility and inter-dependence are better achieved when they are connected with autonomy which is more often the case with open subjects.

Challenging

The situation is not obvious: it can be open and complex, with no easy solution or answer. Let's think this through.

S FOR
LEM STATEMENT

A subject should be attractive not only in content but also in the way it is formulated. Students should feel involved in the resolution of the problem that they are faced with. This may include direct address, questions, and introductory illustrations to make the subject come to life for the readers.

Curiosity

The situation sparks interest.
Hey, I am curious, I want to find out more.

The subject must allow and incite the group to make choices. These choices can be about what is expected from the subject itself (no single solution), but also about the way to organize the work, the choice of resources to use, and the ways of presenting the results and deliverables.

Autonomy

The situation allows students to make choices and offers some latitude in their learning, hence a sense of perceived control. I am in charge.

#	KEYS FOR A GOOD PROBLEM STATEMENT	LOOK IF THE SITUATION
1	Real World	Describes real-life professional or student life situation or mission
2	Achievable	Allows to achieve the stated ILOs with reasonable effort considering prior knowledge
3	Challenging	Is open and begs for a solution and the resources are attractive
4	Curiosity	• Clearly indicates in what capacity students are supposed to handle the situation • Includes references to a wide variety of sources (realistic data, videos and films, press articles, …)
5	Autonomy	Allows students to make choices about: • solution (not unique) • the way to proceed • the resources to use • the way to present the solution
6	Collaboration	Engages the group as a whole: • variety of resources • expression of different points of view • contradictory opinions • need for different points of view
7	Learning	gives all the necessary information to enable students achieve the ILOs

6.4 Analysis of an example of problem statement

24 February 1998
Dear cousin,

KEY 1: real life,
KEY 4: realistic data
and information on TV

This winter I imagine you saw on TV the impacts of the famous ice storm that occurred in January. You probably saw that numerous cities and a significant part of the population suffered greatly during this crisis, but I think it is my sugarbush that suffered the most.

During this storm many of my maple trees lost a large proportion of their branches and their buds. I am quite certain that I will not be able to harvest any sap this spring. In some instances, I had to rebuild my sap collecting system leading to additional investments I had not planned. Our old timers say that we should cover the wounds with tar to prevent sap losses and protect the trees against para-sites and fungi. The foresters from our government have advised us to tap only the trees which have less than 50 percent damage. I think I should cut down all the trees that have been wounded because I sense they will soon die. It is not a forest anymore; it is a battleground.

KEY 6: different points of view, each member of the team may prefer one or the other

KEY 3: this is a dramatic solution, the cousin challenges you to help him

I know that you are completing a degree in biology and worked for many summers with foresters. Have you encountered such problems and what would you do? Your suggestions would be highly appreciated because our own staff do not know much about the subject.

Best wishes,
Peter

KEY 4: Who you are with respect to this situation

KEY 3 : the problem does include multiple possibilities in applying science related to the industry or its economy.
KEY 5: Any suggestion will be of interest.
KEY 6 : you may take different points of view

Different aims pursued by different problem statements / situations

Some problem statements / situations aim at inducing students to produce one or more **deliverables**; other problem statements / situations aim at inducing students to produce a valid **argumentation** or **reasoning** about a question

**Aiming for an actual production:**

EXAMPLE

The Tapas Queen company needs to upgrade the electrical installations of its 200 franchises in the country.
It publishes a call for tender for the upgrading of a pilot installation. As you are a team of interns in a company specializing in electrical installation, your boss asks you to produce a technical study as part of an answer to the call for tender.

Aiming for the analysis of a situation and an argumentation about ways to handle it

EXAMPLE

In Europe, France and Sweden are among the countries with the highest life expectancy (83 years in 2018).
The yearly amount of wine drunk per person and per year is 45 liters in France and 23 liters in Sweden.
You are asked to determine, based on scientific reasoning, whether there exists a correlation between life expectancy and the amount of wine drunk annually.
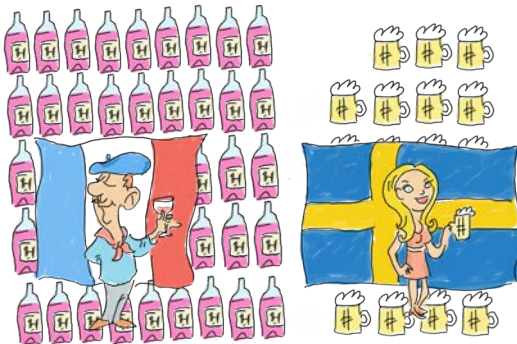
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What are the roles and responsibilities of a PBL tutor?
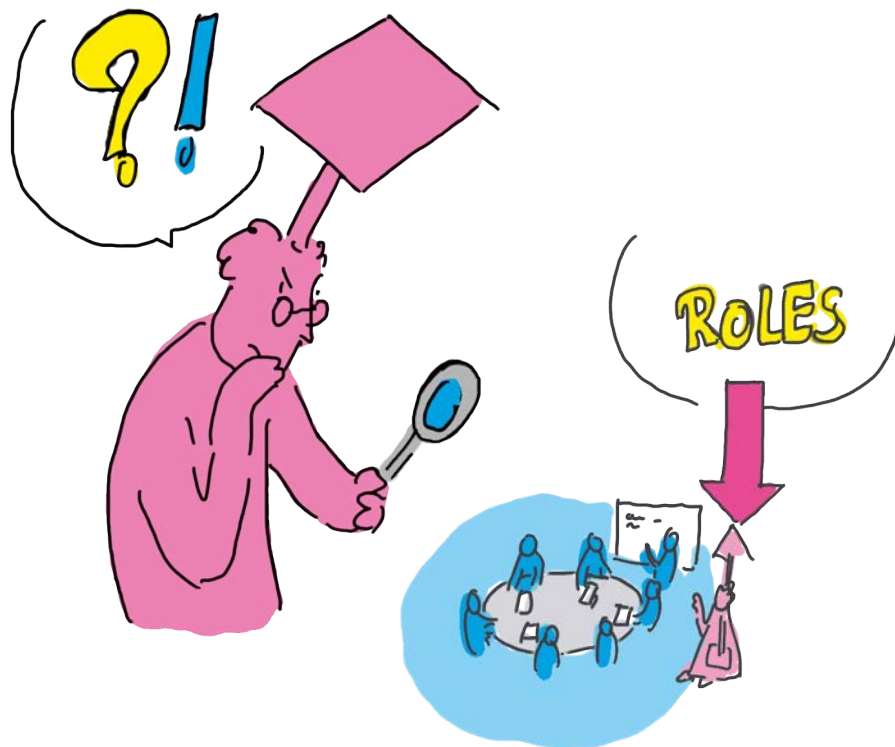
7.1 What are the tutor's main roles?

≪ *'Good teachers' not only provide students with helpful information, but also are empathically responsive (e.g., 'staff make a real effort to understand difficulties students may be having with their work') and seek input from students.* ≫

(Alf Lizzio, Keithia Wilson & Veronica Hadaway, 2007)

OBJECTIVES OF TUTOR-STUDENT INTERACTION

Stimulating contextualized, in-depth learning
The aim is for students to understand meaning, to make connections between subject matter, prior knowledge and personal experience; This will induce them to look critically at what is being learned. ⊘ **Cahier LLL n° 13, 20**

Facilitating self-directed learning
Students (the group) must feel that they are free to organize their own work, to make their own choices. ⊘ **Cahier LLL n° 13, 19**

Creating a safe environment
Students (the group) need to work in a safe social and emotional environment (mutual respect, positive communication, positive emotions).
⊘ **Cahier LLL n° 13, 32**

Encouraging self-reflective practices
Students need to learn to reflect on their learning and professional practices, group dynamics and behavioural/emotional patterns in the professional space, and to be able to express those in a way that facilitates their growth.

EXAMPLES OF ACTIONS UNDERTAKEN BY THE TUTOR

- asking for precision in all statements
- initiating debate on the meaning of key notions
- asking for argumentative reasoning
- initiating the introduction of new ideas

- proposing several possible activities and procedures
- asking students to make choices
- adapting the process to the students' point of view
- asking students to reflect on and establish their own learning practices

- offering students opportunities to express their points of view
- helping students identify and resolve conflictual situations, whether these concern learning outcomes, the learning process or group dynamics

- initiating and facilitating group and personal feedback sessions.

⊘ Cahier LLL n° 13, (Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B. & Van Petegem, S., 2015),l Lizzio, A., Wilson, K. & Hadaway, V. (2007).

7.2 Which tools for the tutor?

Observing students

Analyzing student's learning process by observing what they say, how they interact, what they write, and their non-verbal attitudes to facilitate the learning process.

Asking questions

To gauge the level of understanding of students,to highlight points of disagreement,- to induce them to synthesize the work done.

Initiating and giving feedback

To encourage reflective practices, to push to go further, to clarify, and to share.

The tutor's tools

The tutor's areas of action

Subject matter

Supervising students in terms of knowledge acquisition.The tutor asks for clarification or for additional explanation, suggests a counter-example, points to inconsistencies or incompleteness, ...

PBL process

Coaching students in the three-phase process, making sure that no step is overlooked.The tutor encourages, helps to overcome obstacles; he/she does not provide solutions, but helps the group reach a solution independently and autonomously;...
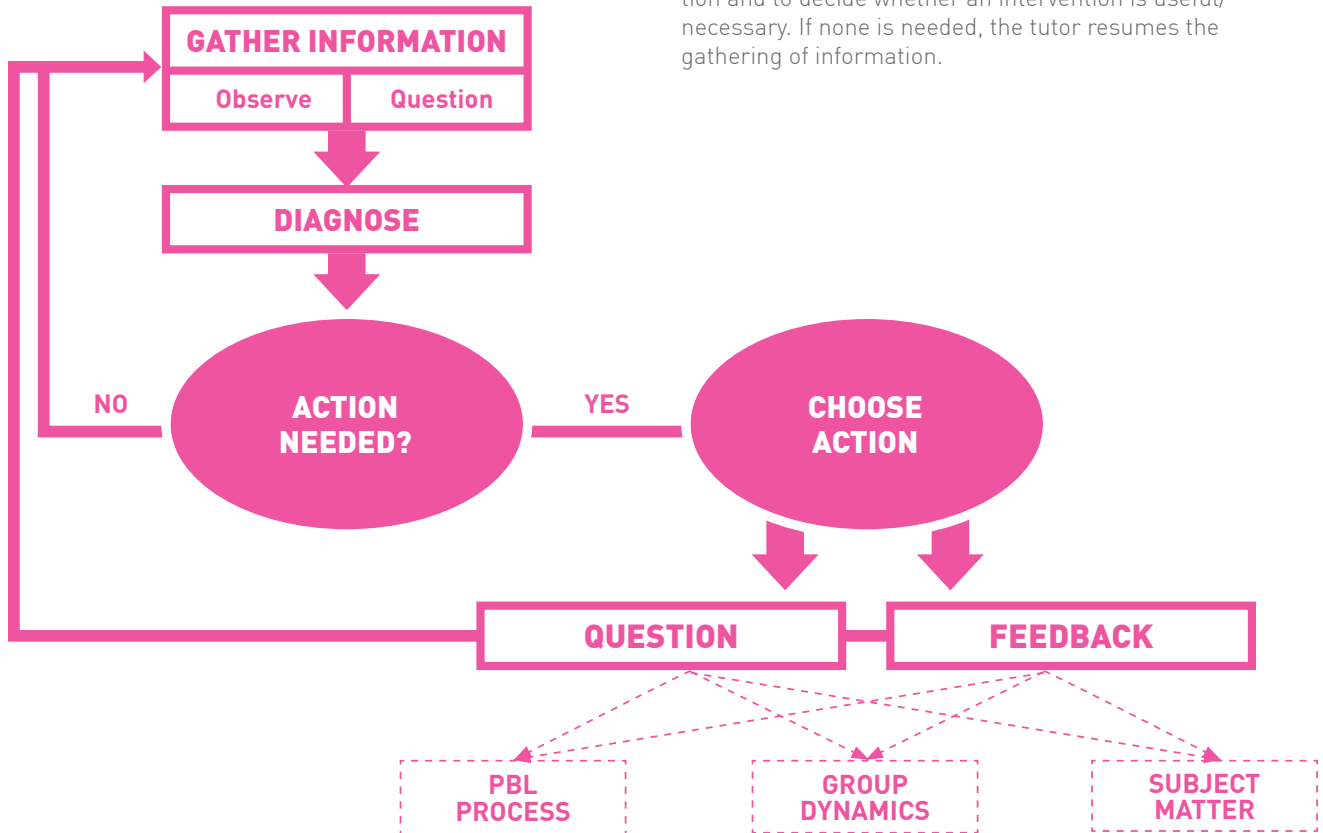
Group Dynamics

Coaching students in fruitful interactions, regulating exchanges, promoting cooperation, encouraging initiative, autonomy and leadership ...

7.3 What the tutor does

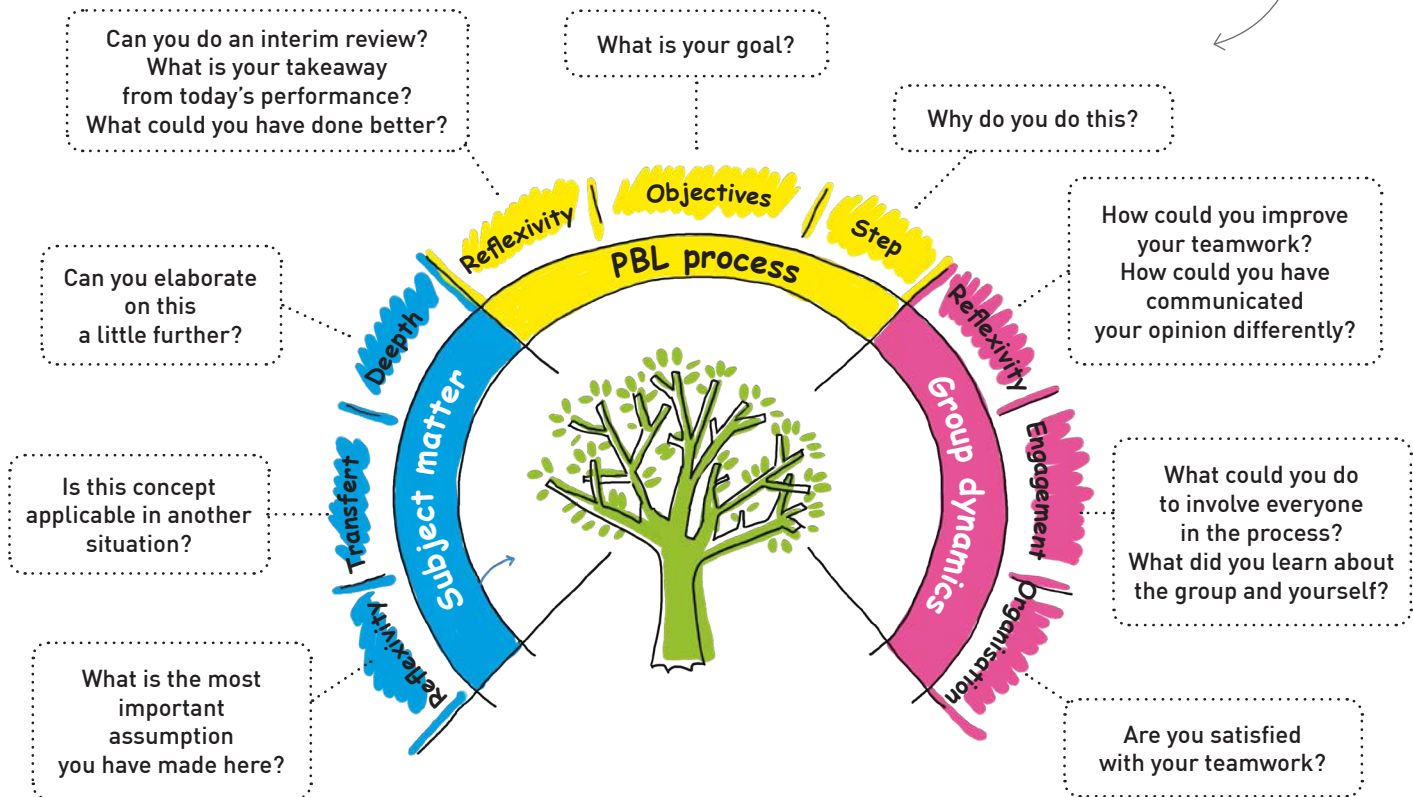The overall mission of the tutor is to facilitate students' learning.

The tutor constantly gathers information about what happens in the group: this is done by observing the workspace and the interplay between students and/or by asking questions.

This enables the tutor to diagnose the current situation and to decide whether an intervention is useful/necessary. If none is needed, the tutor resumes the gathering of information.

GATHER INFORMATION

Observe | Question

DIAGNOSE

ACTION NEEDED?

NO

YES

CHOOSE ACTION

QUESTION

FEEDBACK

PBL PROCESS

GROUP DYNAMICS

SUBJECT MATTER

Cahier LLL n°13 + Livre de Boeck

7.4 The art of questioning: the questions tree

The questions tree is a tool to allow the tutor to build his or her intervention

EXAMPLES

Can you do an interim review?
What is your takeaway
from today's performance?
What could you have done better?

What is your goal?

Why do you do this?

Can you elaborate
on this
a little further?

How could you improve
your teamwork?
How could you have
communicated
your opinion differently?

Reflexivity

Objectives

PBL process

Step

Deepth

Reflexivity

Engagement

Transfert

Subject matter

Group dynamics

Organisation

Is this concept
applicable in another
situation?

What could you do
to involve everyone
in the process?
What did you learn about
the group and yourself?

Reflexivity

What is the most
important
assumption
you have made here?

Are you satisfied
with your teamwork?

7.5 What to to and what not to do as a tutor?

☑

THE TUTOR IS

- constantly aware of the Intended Learning Outcomes (ILOs)
- familiar with the material of the PBL unit

WITH RESPECT TO STUDENTS, THE TUTOR IS WATCHFUL

- attentive to the needs of every student
- understanding
- equanimous
- open to different ideas
- caring and benevolent
- fair

☒

THE TUTOR DOESN'T

- teach or direct students' work
- do work which should be done by students
- force his own opinions or preferences upon students
- provide answers which can be found in resources provided to the students
- provide answers to questions to which students can be led to find the answers by themselves
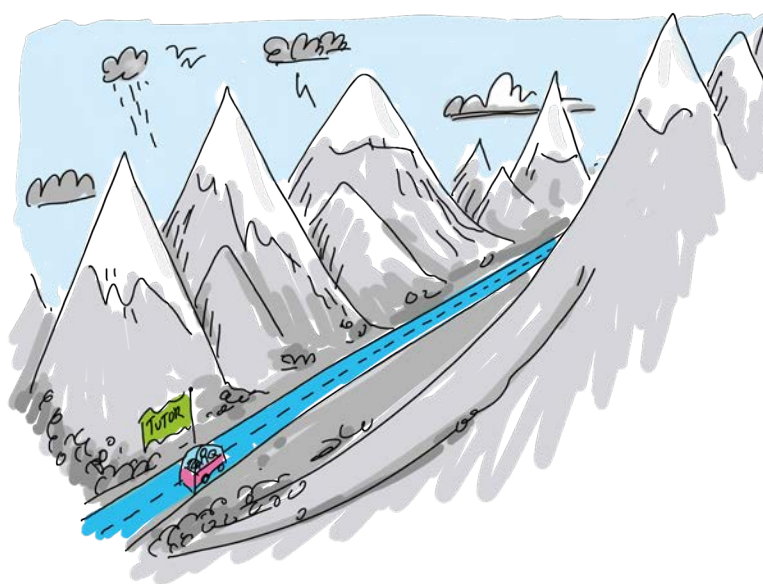
7.6 How to reflect on tutoring practices?

Every tutor's experience is different since all student teams are different.
Since tutoring is a demanding job (and an unfamiliar one for many teachers), tutors should always be on the lookout for new situations which arise during the PBL process and new ways to handle such situations.
In the same way that students benefit from teamwork, tutors do too!

- **Periodic meetings of all tutors involved** in a course are necessary to help tutors progress in their tutoring. These peer-to-peer sessions allow tutors to share their experience and advise each other.
- **The course coordinator should be** present at these meetings not only for quality control but also in an advisory role.
- **Observing** other tutors in action and **share feedback on each others' practices** are other ways to reflect on tutoring practices.
- Collecting tutors' reflection on their tutoring **in writing** (in reports to course managers/coordinators or by filling in questionnaires) is also an efficient way to improve tutoring quality.
- **Asking students for feedback** on tutoring practices / quality is **also a great source of information**. This can be done by the tutor at the end of each session and shall not only improve tutoring quality but might reinforce team dynamics. Another way of gathering student feedback is in writing at the end of the PBL unit. This needs to be organized by course coordinators.

⊘ 3.5
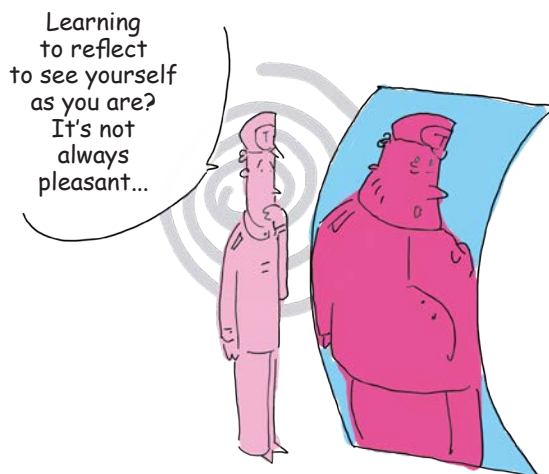
7.7 How to provide feedback to course designers?

If there are many student teams, PBL unit designers are not always able to personally observe the actions of a significant number of teams. Tutors, on the other hand, are well-positioned to provide useful feedback to designers

- on shortcomings of the material provided to students and/or to tutors and on possible improvements
- on wrong estimates of timing requirements to do the work needed to achieve the ILOs
- on unexpected obstacles or difficulties which arose during the PBL process
- on teams experiencing difficulties with teamwork
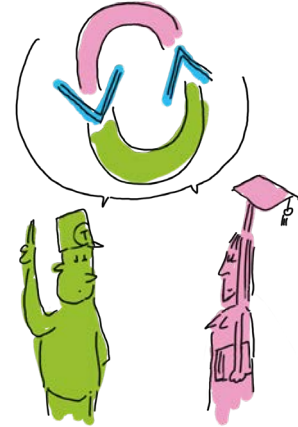
7.8   How to contribute to formative assessment?

Through their questioning during tutorial sessions, tutors have many opportunities to probe students, to assess their progress towards the PBL unit's ILOs, and to nudge students whenever necessary towards the goals of the unit.

Tutors need also to organize regular individual feedback sessions with students allowing students to reflect, with the tutors' guidance, on:

- their own learning practices
- achieving IOLs (knowledge, professional know-how and transferable skills)
- personal growth (map of emotions)

7.9 How to contribute to summative assessment?

The tutor's mission usually does not entail summative assessment of IOLs, especially knowledge acquisition.
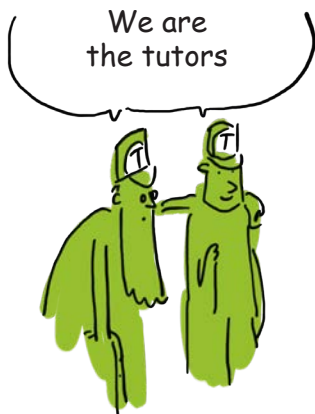
However, tutors may provide students with methodological and bibliographical advice to help them prepare for summative exams.

Some PBL units may include ILOs relating to the quality of teamwork or other transferable skills. Tutors may then be asked to provide evidence for summative assessment of such ILOs. In this case, tutors shall be given a duly prepared evaluation form by course coordinators that contains properly defined assessment criteria.

Students should of course be informed when tutors will observe their performance and gather evidence for an assessment, since this interferes with the "standard" mission of the tutor.

My role is to accompany, not to assess

My role is to accompany, not to assess
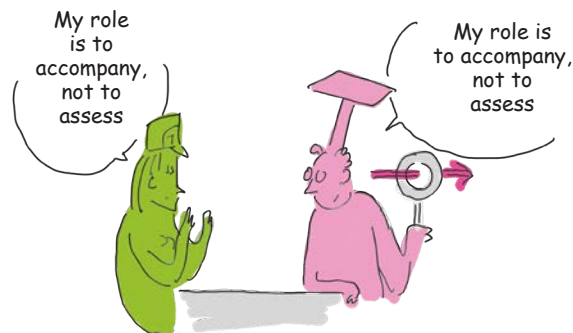
7.10 What about the expertise of the tutor?

We are the tutors

To be a good tutor, one needs to have expertise in the three areas of tutor action ⊘ **7.2.**

Expertise in the subject matter is normally provided by education or through expertise acquired at work. However, tutors don't always need to be experts in the subject matter. Thus, teachers or students in higher grades might be efficient tutors. Expertise in the PBL process and group dynamics are the subject of specific training ⊘ **8.7.**

≪ *The training of tutors was greatly facilitated when we recruited people who had themselves followed a PBL module as they already knew the PBL pirnciples...* ≫
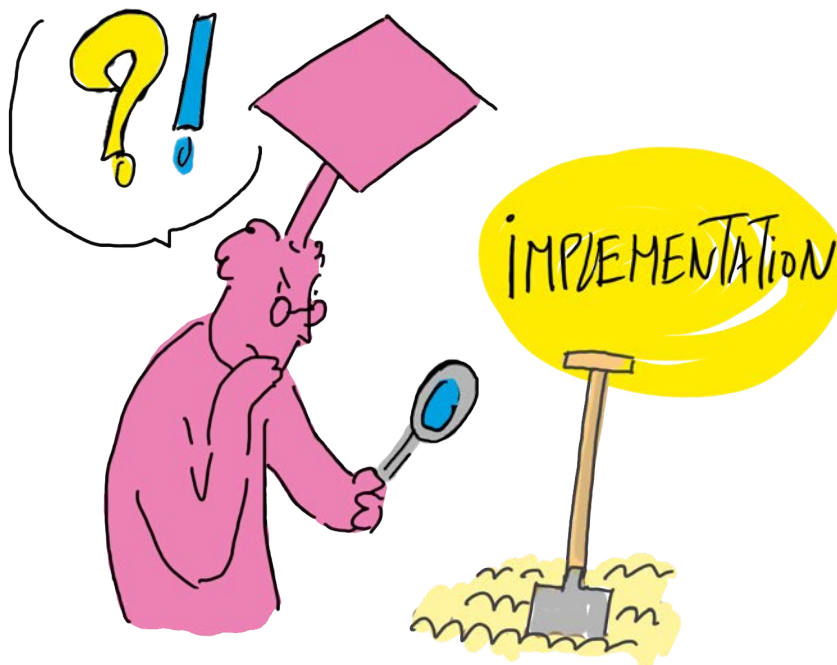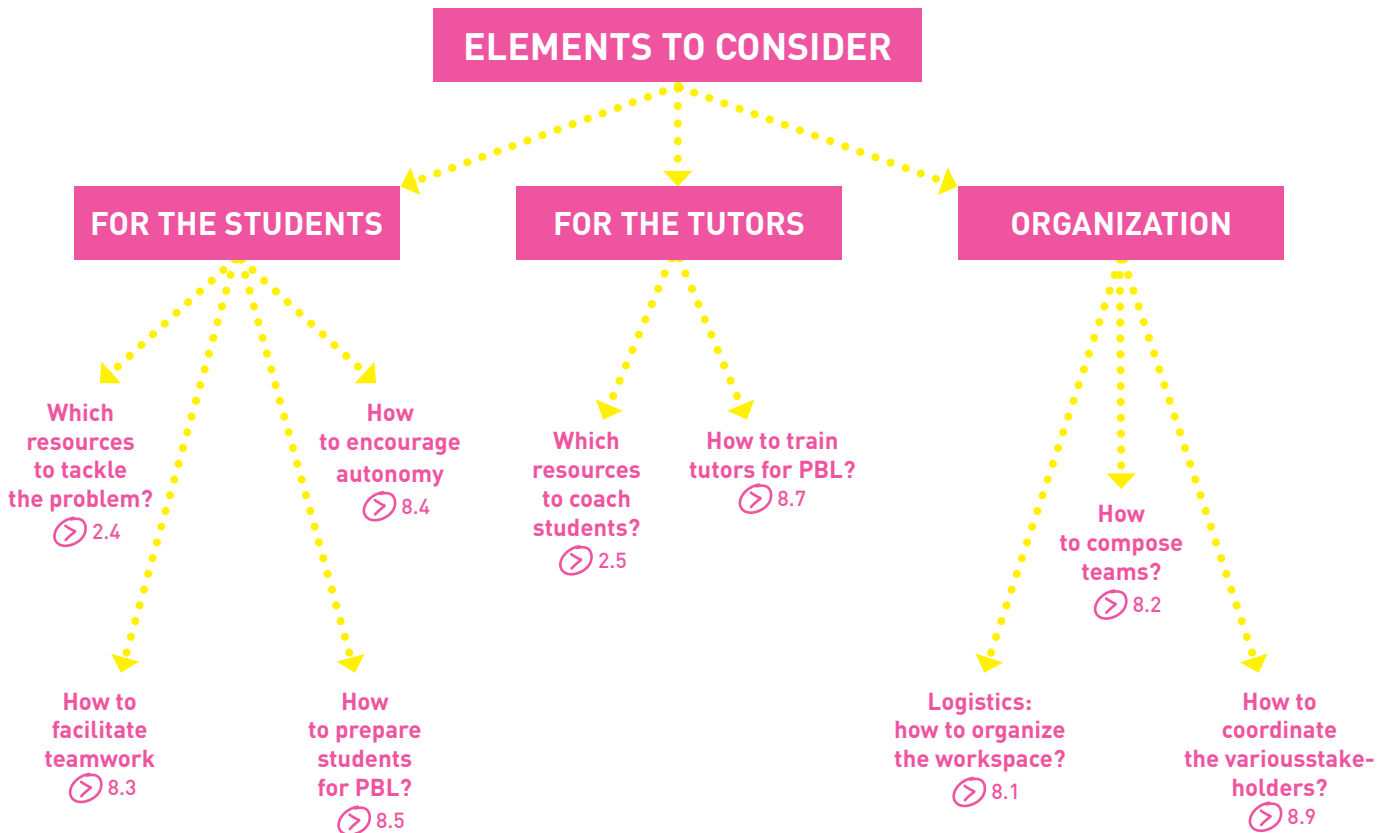One tutor trainer

8

What to consider before implementing PBL?

There are numerous considerations to take into account before integrating PBL into a course or into a whole curriculum.

For example, setting out PBL in a single course requires first laying out the learning objectives of the course and, second, how these objectives will be incorporated into problems. For a complete PBL curriculum, the same exercise is required but at a different level since all the classes will rely on PBL and this requires redesigning the curriculum ⊘ **5.5.**

Numerous institutions have completed the switch to PBL; Bernstein et al. (1995) have, however, pointed out the need to anticipate and to manage anxiety among students and faculty.
Here are a few elements to take into consideration.

ELEMENTS TO CONSIDER

FOR THE STUDENTS

Which resources to tackle the problem? ⊘ 2.4

How to encourage autonomy ⊘ 8.4

How to facilitate teamwork ⊘ 8.3

How to prepare students for PBL? ⊘ 8.5

FOR THE TUTORS

Which resources to coach students? ⊘ 2.5

How to train tutors for PBL? ⊘ 8.7

ORGANIZATION

How to compose teams? ⊘ 8.2

Logistics: how to organize the workspace? ⊘ 8.1

How to coordinate the variousstake-holders? ⊘ 8.9

8.1 How to organize the workspace during tutorials?

Every group should be attributed a workspace which facilitates teamwork:
• a table, preferably round
• chairs, if possible, easy-to-move (+ one spare for the tutor !)
• a common workspace (white board, paper board, shared screen, ...)
• connections (electricity, network, ...)
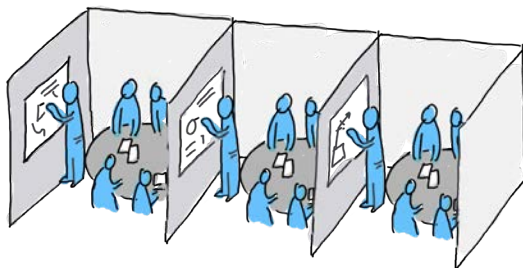
If it is necessary to accommodate more than one group per room, one should make sure that groups are far enough from each other to prevent interference due to excessive noise. Some physical separation between groups can be useful in this respect.

If a room accommodates several groups, one can
    • either have one tutor per group (expensive !)
    • or one "roving" tutor for all the groups in the room
      (more complicated for the tutor: requires more expertise)
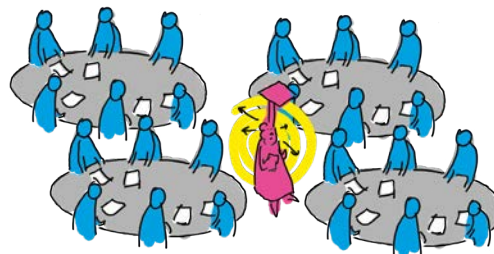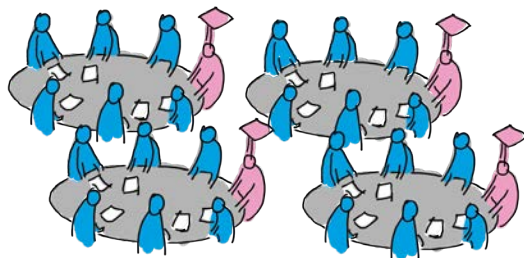
8.2 How to compose groups for teamwork?

It is usually not a good idea to let students choose to which group they wish to belong, as they tend to congregate with their friends or with students with similar backgrounds and/or profiles.

Heterogeneity within groups is considered to be advantageous for the kind of teamwork to be accomplished during PBL tutorials:
- more ideas
- more diverging viewpoints
- more different approaches
- more controversy
- better representation of a future work environment

> The ideal number of students within a group is somewhat disputed among PBL experts; we recommend between 5 and 8 (included):
>
> - less than 5 may fail to yield sufficiently active discussions and debates;
> - more than 8 may result in subgroups forming spontaneously and less global sharing.
>
> ⊘ 5.2
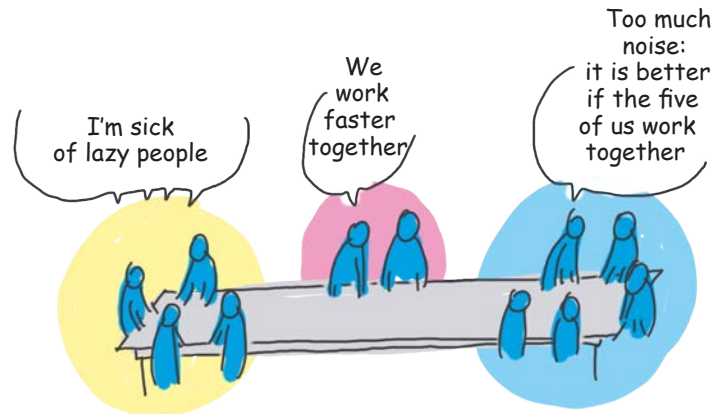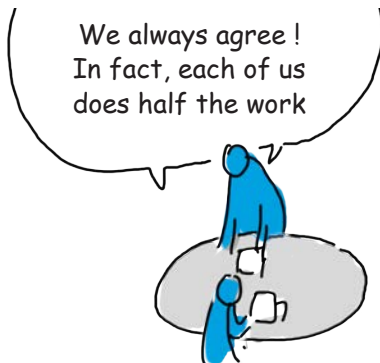
8.3 How to facilitate teamwork?

It is fundamental to focus the work of the group on learning and to facilitate the focus of the group.

《《 *Spontaneously, a group functions as a group of friends, aiming mostly to get along well… and to avoid annoying subjects or situations. A group of friends also have the tendency to divide the tasks so that each students sticks with what he/she already knows how to do.* 》》

(A tutor)

SOME ROLES TO FACILITATE GROUP FUNCTIONING

Helmsman	Scribe	Secretary	spokes person	Timekeeper

You ensure the group achieves its goal and is focused on the objectives.
You make sure the group stays on topic and that everyone participates.

You take notes on the board and make sure information is visible for each member of the group.
You make sure all opinions are recorded.

You take note of the synthesis of the discussions and decisions, you share this information with everyone.

You represent the group's point of view.
You speak to the tutor in the name of the group to formulate requests or to indicate problems.

You make sure that the meeting doesn't run on too late and that there is enough time to talk about everything on the agenda.
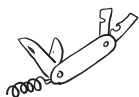
These roles may rotate among students from one tutorial to another giving the opportunity for each student to experience the given responsibility.

It is not enough to provide cards describing the roles, students must be trained and encouraged to use them effectively.

8.4 How to encourage and support autonomy?

The second phase of the PBL process ⊘ 2.3 consists in autonomous work to be performed by every student.
The autonomous work to be done is decided by the group (nudged by the tutor) during the first tutorial session (phase 1); the results of the autonomous work of every group member is used in the second tutorial session (phase 3).

The problems to tackle are:
• why would students do the work assigned to them by the group?
• how does one encourage students to do the autonomous work conscientiously?

There have to be good reasons for doing the prescribed autonomous work (and maybe some threats for not doing it...).

Students will be encouraged to do the work if they feel

• that they have had a say in what has to be done (one of the aims of the 1st tutorial)
• that the objectives to be reached by the work appear to be reachable (based on what students currently know thanks to previous learning)
• that the objectives to be reached by the work appear to be useful w.r.t. the course ILOs (and the final assessment)
• that the amount of work is reasonable and fits in the weekly schedule.

• they have access to self-assessment questions to measure their progress during and at the end of the autonomous work
• that they can usefully contribute to the group during the 2nd tutorial
• that tutors prod them during the 2nd tutorial to ascertain the quality of the autonomous work performed by every student
• that the level of social pressure is adequate.

8.5 How to prepare students for PBL?

Moving from a teacher-centered, mostly transmissive pedagogy to an active, cooperative, situated, and tutored pedagogical method induces a cultural shock in many students. Like all human beings, students are inherently conservative: they prefer what they know (even if they don't like it much) to the unknown (which is always somewhat frightening).

There are three main approaches to overcome the obstacle of novelty:
• start with a lecture describing the PBL process and its numerous advantages (from the point of view of the teachers);
• throw students in the water hoping that most of them will learn to swim, i.e.: let them experience their first PBL unit without any special preparation;
• organize an activity leading to the discovery of the PBL process in a somewhat milder form.

We favor the third approach, certainly for students with little or no experience of higher education. At the School of Engineering of UCLouvain, the first week of the first semester for new students is devoted entirely to acquainting students gradually (and softly) with:

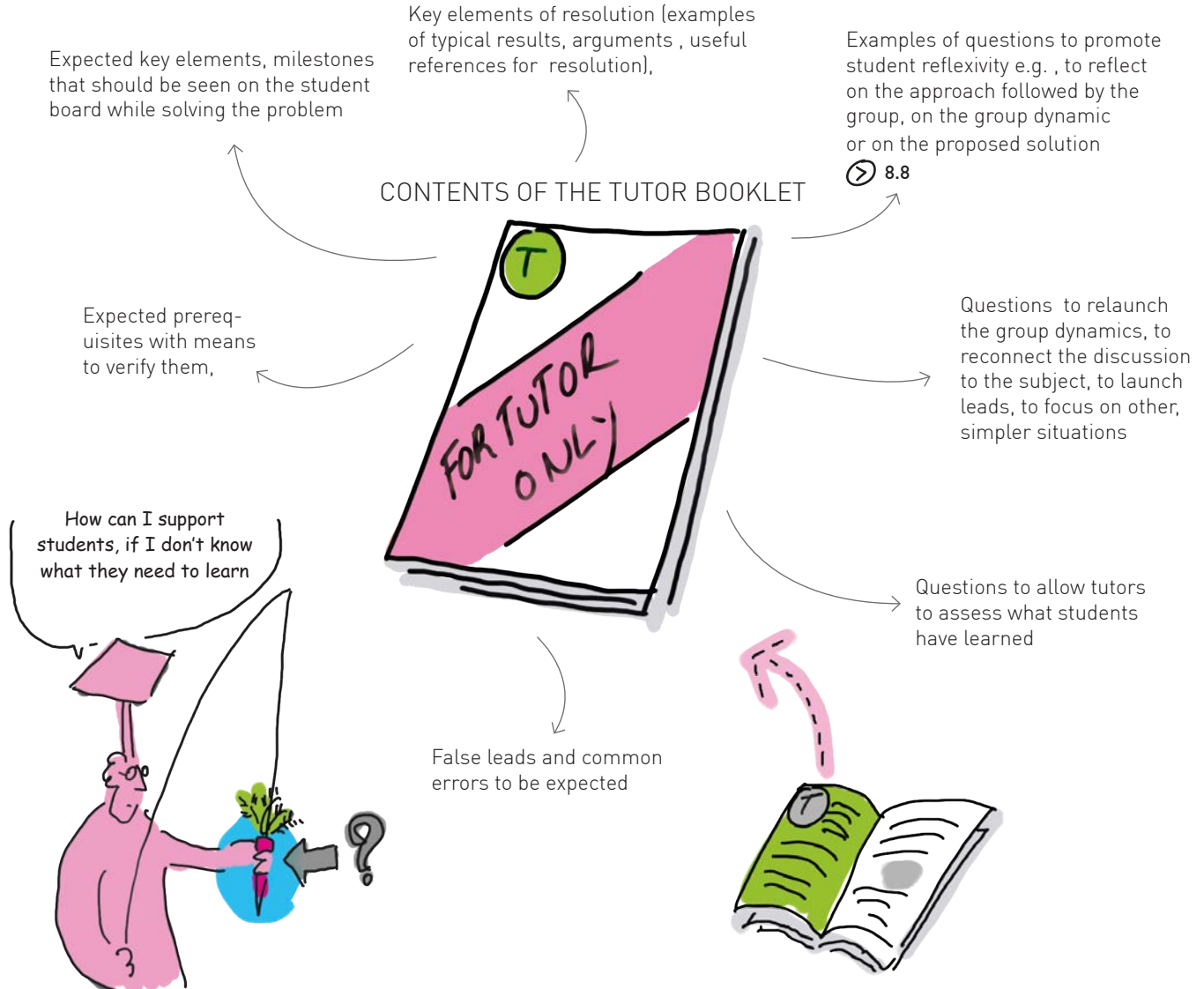• working in groups, including the various functions within a group ⊘ 8.3
• reading and understanding a problem statement
• the phases and steps of the PBL process
• the use of the common workspace
• the role of the tutor
• the university, its resources, and its campus

This first week is organized around a PBL-like process with many more intermediate tutored sessions than in the standard model:
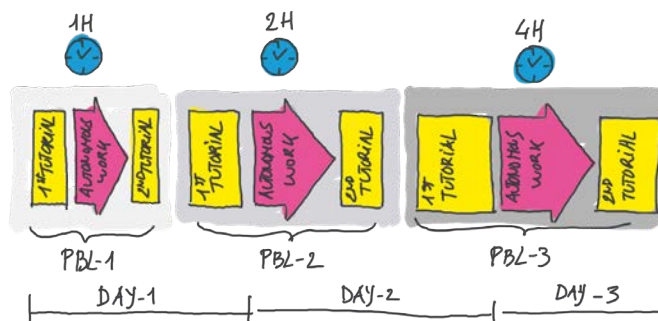
8.6 Which resources for tutors to coach students in PBL?

All information needed by the tutor for a PBL unit is preferably made available in a tutor booklet

Key elements of resolution (examples of typical results, arguments , useful references for resolution),

Expected key elements, milestones that should be seen on the student board while solving the problem

Examples of questions to promote student reflexivity e.g. , to reflect on the approach followed by the group, on the group dynamic or on the proposed solution

⊘ 8.8

CONTENTS OF THE TUTOR BOOKLET

Expected prereq-uisites with means to verify them,

Questions to relaunch the group dynamics, to reconnect the discussion to the subject, to launch leads, to focus on other, simpler situations

FOR TUTOR ONLY

How can I support students, if I don't know what they need to learn

Questions to allow tutors to assess what students have learned

False leads and common errors to be expected

BEWARE!
If the tutor is given a standard answer, he/she will tend to get the students to give the same answer...

Hum, I am surprised because your approach seems good, but your solution is not the one I expected...

GOOD ... GOOD ... YOU ARE DOING WELL ... AND WHAT ABOUT IF ...

We found it useful to combine the student booklet (odd pages) and the tutor booklet (even pages). This way the tutor knows exactly what is given to the students and what is specific to his role as tutor.

WELL ... I DON'T KNOW WHERE TO LOOK TO ANSWER YOUR QUESTION...

...

8.7 How to train tutors for their new roles?

The roles and responsibilities of a tutor ⊘ **7** are quite different from what is usually expected from teachers: it's an entirely different job, which has to be learned.

Learning to be an efficient tutor usually involves:

- experiencing a PBL unit as a learner to better grasp the difficulties facing students in the PBL process
- reading about tutoring
- observing experienced tutors in action and analyzing their behavior with other tutors
- practicing tutoring while being observed by experienced tutors and receiving feedback about one's performance
- observing other tutors and helping them improve their performance

> Practice makes perfect, but only if I get useful feedback!
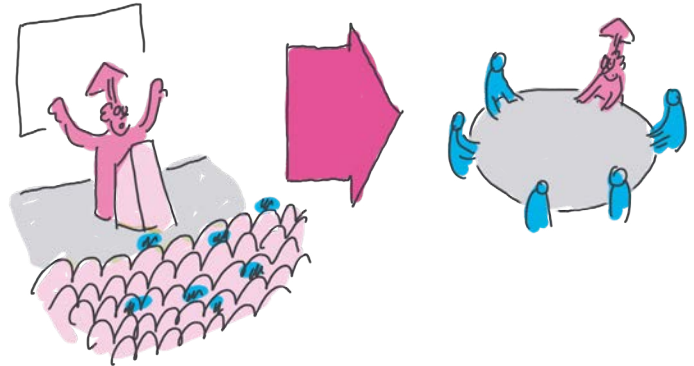

At the School of Engineering of UCLouvain, each year about 150 Master-level students are trained to become tutors and to supervise bachelor-level students. The training includes participation in the APP0 week for first year students, with information, coordination and reflective practice sessions.
⊘ (Raucent et al 2004), (Wilkerson and Hundert 1997), (Raucent et al 2021)

8.8 **How to promote reflexivity?**

Since the main purpose of the PBL process is the learning process – and not the production of a solution of the initial problem situation (as many students tend to believe) – it is essential to draw students away from the universe of the problem itself to focus on the learning achieved during the process and to identify paths for improvement ; this is an important part of the action of the tutor ⊘ **7**
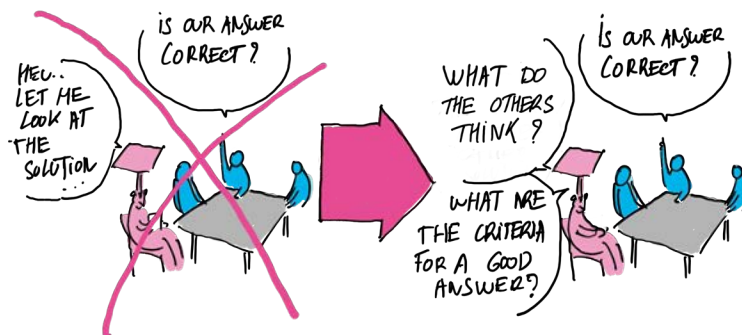
EXAMPLES
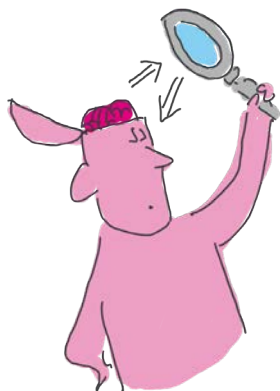
TUTOR QUESTIONS TO PROMOTE REFLEXIVITY

Reflecting on the process	Can you describe the steps taken by the group and their outcomes?
Reflecting on group dynamics	Are you satisfied with your group work? What will you do differently in the future?
Reflecting on the problem	If we were to look at simpler case, how would you handle it?
Reflecting on the subject matter	What can you do now that you couldn't do before?
Reflecting on learning practices	How could you better organize your autonomous work in the future?

8.9 How to manage and coordinate the various stakeholders?

Introducing PBL in a curriculum – or even in a single course – will often result in resistance or obstruction not only because of the amount of work involved, but also because of the numerous changes it entails in tradition and day-to-day practices.

Success breeds success, but failure breeds failure! If there are too many hiccups during the introduction of PBL, opponents will often marshal enough forces to return to conventional pedagogical practices. This is why there is no room for failure and success **must** be achieved.

In most teacher-centered transmissive pedagogies, teachers have a lot of leeway to organize their teaching activities autonomously, i.e.: with little need to coordinate with other teachers once the course schedule is established, usually by the administration.

In PBL pedagogy, many stakeholders need to cooperate in order for the system to work properly ⟩ 5:
- during the design phases
- during the implementation
- during the execution

At the curriculum level, coordination is needed to ensure
- that the requirements for the various courses are compatible with each other, e.g.: that the student workload is reasonable and balanced during the semester (no peaks due to conflicting deadlines)
- that schedules can be quickly adapted to unexpected occurrences

**At the course level, coordination is needed to ensure**
- the availability of tutors and experts
- the availability of external resources (e.g.: laboratories)
- quick reaction to unforeseen incidents: unexpected difficulties, wrongly estimated study times, ...
- adequate feedback to PBL Unit designers to improve the quality of PBL units (documents, resources)
- adequate feedback among tutors to build upon each tutor's experience
- ...

IN PBL, STUDENTS WORK IN TEAMS – AND TEACHERS DO TOO!

EXAMPLE:
## COORDINATION AMONG TUTORS

Before and after tutorial sessions, it is recommended to set up coordination meetings between tutors, led by a tutor coordinator

The coordination meeting is conducted in the same way as the student tutorials: roles are defined among tutors, objectives and deadlines are set,....
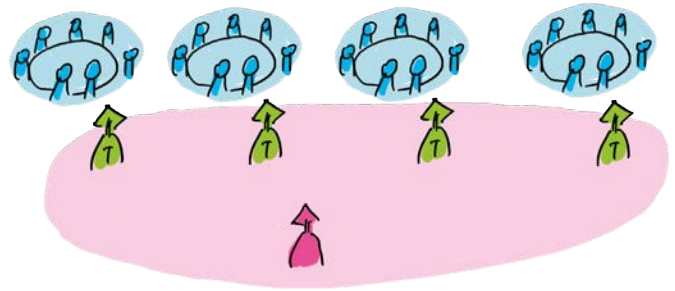
The purpose of the coordination meeting is to take stock of what has happened in the past and to prepare what will happen next. It focuses on difficult points, common mistakes,... It also aims at promoting reflexivity among the tutors
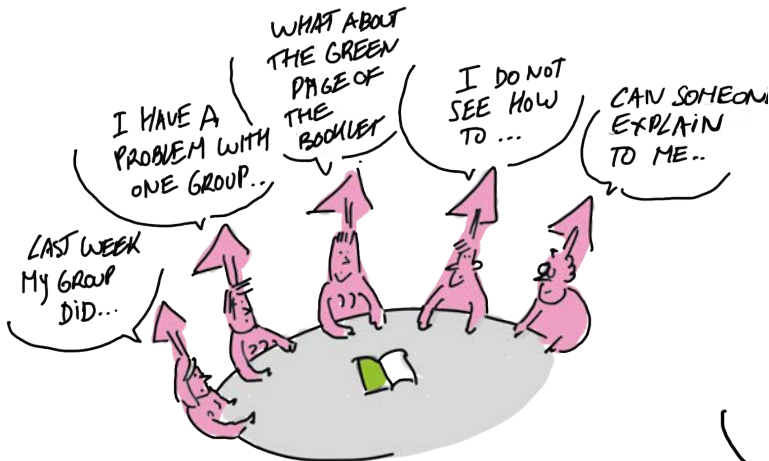
BIBLIOGRAPHY

- *AACU* **Value-All Rubrics** (https://www.aacu.org/initiatives/value-initiative/value-rubrics)

- *Barrel, J.* (2006). **Problem-based learning**, an inquiry-based method, Corwin.

- *Bernstein, P., Tipping, J., Bercovitz, K. & Skinner, H.A.* (1995). **Shifting students and faculty to a PBL curriculum: attitudes changed and lessons learned.** Academic Medicine: 70: 245-247.

- *Bloom, B. S.* (1956). **Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain.** New York: David McKay Co Inc.

- *Brown Wright, G.* (2011) **Student-Centered Learning in Higher Education. International Journal of Teaching and Learning in Higher Education**, 23: 92-97.

- *Chi, M. T. & Wylie, R.* (2014). **The ICAP framework: Linking cognitive engagement to active learning outcomes.** Educational Psychologist, 49(4), 219-243.

- *EHEA Employability* (http://www.ehea.info/pid34423/employability.html)

- *Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B. & Van Petegem, S.* (2015). **Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation.** Psychology of Sport and Exercise, 16, 26-36. doi:10.1016/j.psychsport.2014.08.013

- *Johnson, D.W. & Johnson, R.T.* (2002). **Cooperative Learning and Social Interdependence Theory.** in: Theory and Research on Small Groups. Social Psychological Applications to Social Issues, vol 4. Springer, Boston, MA. doi:10.1007/0-306-47144-2_2

- *Lizzio, A., Wilson, K. & Hadaway, V.* (2007) **University students' perceptions of a fair learning environment: a social justice perspective, Assessment & Evaluation** in Higher Education, 32:2, 195-213, DOI: 10.1080/02602930600801969

- *Mauffette, Y., Kandlbinder, P. & Soucisse, A.* (2004). **The problem in problem-based learning is the problems: But do they motivate students?** Pp 12-25 In M. Savin-Baden and K. Wilkie (eds.) **Challenging Research into Problem-based learning Buckingham:** SRHE and Open University Press.

- *Moallem, M., W. Hung et Dabbagh, N.* (2019). **The Wiley Handbook of Problem-Based Learning.** John Wiley & Sons, NJ, USA.

- *Raucent, B., Moore, G. and Bourret, B.* (2004) **What are the conditions required for designer and tutor training in an active learning approach?**, Proc. of 4th int. Workshop on Active Learning in Engineering Education, Nantes, June 2004, pp 57-65.

- *Raucent, B., Milgrom, E., Romano, Ch.* (2020) **Guide pratique pour une pédagogie active : Les APP**, INSA Toulouse, Ecole Polytechnique de Louvain, second edition.

- *Raucent, B., Wertz, V., Ducarme, D., Banaï, M., Jacqmot, Ch., Oestges, C., and Milgrom, E.* (2021), **La formation des tuteurs par immersion, in Accompagner les étudiants**, sous la direction de Raucent, B., Verzat, C. Van Nieuwenhoven and Jacqmot, Ch., Deboeck supérieur, pp 307-328, 2021.

- *Servant-Miklos, VFC.* (2019) **Fifty years on: A retrospective on the world's first problem-based learning programme at McMaster University Medical School**, in Health Professions Education 5 : 3-12.

- *Soucisse, A., Mauffette, Y. & Kandlbinder, P.* (2003). **Les problèmes: pivots de l'apprentissage par problème (APP)** Res Academica, 21 (1) 129-150.

- *Van Berkel, H., Scherpbier, A., Hillen, H., van der Vleuten, C.,* (2010) **Lessons from problem-based learning**, Oxford University Press.

- *Wilkerson, L. and Hundert, E.M.,* **Becoming a problem-based tutor: increasing self-awareness through faculty development**, in: The Challenge of Problem-based learning, ed. by D. Boud and G. Feletti, Kogan Page, pp160-172, 1997.

- *Yorke, M.* (2006) **Employability in Higher Education: What It Is, What It Is Not,** The Higher Education Academy (https://www.researchgate.net/publication/225083582)

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To Christine, our beloved colleague who passed away on August 31 2023.

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Elie Milgrom was one of the leading proponents of the introduction of active learning – and more specifically – PBL in the School of Engineering at UCLouvain around the year 2000. He has since retired as a professor of computing science and devotes as large part of his time to helping faculty in many mostly European universities to switch to active learning methods and to aim for pedagogical alignment.

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Currently, she in charge of a problem-based learning programme at the medical faculty and tutor training, and her research explores the (inter)cultural, systemic, cognitive (and linguistic) determinants of the feasibility of upscaled, student-led, innovative pedagogies.

You want to develop a pedagogical activity
based on PBL for one of your classes? ....

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