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Problem-Based Learning (PBL)

How to Teach

What is PBL? Problem-based learning evolves around a problematic situation or case, where problem solving skills are required. Unlike exercises, which may also be based on a problem but focus on practicing and applying existing knowledge (with a known solution), this approach involves actively solving ill-defined problems, where new knowledge is generated in the process.

Why should I incorporate PBL into my lectures?

→ To foster problem-solving and analytical skills, self-efficacy, critical thinking, and independent learning.

→ To promote student engagement.

→ To encourage collaborative problem-solving.

Phases/Procedure: „Seven-Jump Method“

1. Confrontation: The lecturer presents the problem and answers questions of understanding. Solutions and ideas are not allowed during this phase.
2. Problem definition and analysis: What aspects of the situation are important? How can we sharpen / define the problem/ or sub-problem? Result of this phase is a clear problem definition.
3. Hypothesis building: Collect ideas/hypothesis, solutions of the students on how to solve this problem. This phase links the problem situation with the students' individual prior knowledge.
4. Goal formulation: Based on the problem definition and hypothesis, students define clear learning goals for themselves. What content they want to engage with, what resources they consider, etc.
5. Self-studies: Individual self-studies or group work; reading relevant literature; search for information, talk to experts, etc.
6. Synthesis: Presentation of the results, discussion of unfitting solutions or wrong hypothesis, decision for a solution, maybe problem redefinition, and new hypothesis building, etc.
7. Reflection/securing of insights: Lecturers complete or correct students' learning outcomes, moderate reflections on work and problem-solving processes, provide individual feedback, etc.

Students' activities:

- Think about the presented problem situation: Is there something I do not understand? Is this a relevant situation?
- Bring in their knowledge and experiences.
- Define hypothesis, questions and learning goals.
- Gather information by themselves.
- Argue and discuss with other students.
- Guided by the lecturer's moderation, students think, share, and discuss their experience.

Lecturer' activities:

- Define relevant, interesting, actual problem situations.
- Design learning environments (e.g., decide on relevant literature or other resources).
- Clear questions, moderation of the problem-solving process, without defining "one right solution".
- Support students during the working phase.
- Secure knowledge and extend, complete or correct learning results.

Notes

- Problem situation must be relevant, understandable, and customized to the target group (students).
- Depending on the target group a different level of structuring of the problem-solving process is required by the lecturer.
- Problem solving process should be made explicit, so that students reflect what they are good at and where they have potential for development.

Why is it important to define a good problem?

Effective learning is triggered by challenging yet solvable problems that encourage students to think. A good task requires students to activate and recombine existing knowledge rather than simply retrieve information routinely. Problems are not negative but represent a cognitive challenge that fosters intrinsic motivation and interest among students.

Sources

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How to Construct

How are problems developed? Problems are developed as part of the lesson planning process and are aligned with the underlying learning objectives. There are various types of problem, which differ according to the dimensions of the respective learning objectives. Additionally, problem types can be categorised based on the scope of the information provided and the level of uncertainty they create for learners. By considering these variables, lecturers can adjust the difficulty level of a problem to suit learners' needs:

Differentiation according to learning objective levels: A problem type is designed for each level. However, the "knowledge" taxonomy level is not assigned its own type of problem, as it is regarded as the result of problem solving at higher levels, rather than a prerequisite for it. In this case, knowledge is the outcome rather than the starting point.

Differentiation according to degree of uncertainty: This distinction describes how clearly the initial and final states, and the necessary transformation process are defined. In this way, the degree of difficulty of the problem can be varied (see page two).

Problem types according to learning objective levels:

1 Explanation problems (level of understanding)
The following is required to solve these problems:
- reproduce a fact in own words
- summarise the main points
- draw conclusions or derive consequences

2 Transfer problems (application level)
This involves applying abstract principles to specific examples.

3 Analysis problems (level of analysis)
This type of problem requires breaking a situation down into its individual parts, isolating elements and identifying relationships and work out the organizing principle of a unit.

4 Design problems (level of synthesis)
These problems involve creating your own texts, drafts, plans or arrangements.

5 Assessment problems (level of evaluation):
This involves evaluating cases based on criteria, such as identifying advantages and disadvantages, establishing rankings, and making decisions.

Problem types according to degree of uncertainty:

Interpolation problems: In this type of problem, the initial and final states are clearly defined, as are the means necessary to reach the final state. The only uncertain factors are the sequence and combination of these means.

Discovery or structuring problems: In these problems, the initial and final states are clearly defined, but not all the ways in which they can be transformed are known. This requires creativity in order to discover new means or restructure existing ones from a new perspective.

Dialectical problems: In this type of problem, the initial state is clearly defined, but the goal is vague. This vagueness often manifests itself in comparative criteria such as 'faster', 'more customer-friendly' or 'more competitive'. Goals and means evolve through an iterative process of planning and evaluation.

How can the difficulty level of the problem be adjusted?

The difficulty level of a problem can be adjusted in various ways, but this must always be considered in relation to the students learning requirements. For example, what is a discovery problem for one student may already be an interpolation problem for another because they already know the missing information. Similarly, a problem designed as an interpolation problem may become a discovery problem if students lack the necessary prior knowledge.

Lecturers must adapt the level of difficulty of tasks to suit learners' needs. This can sometimes be done during the planning stage, but it is often only recognised during classroom application.

If students are underchallenged, the lecturer can prepare additional questions that aim for a higher level of learning or increase the degree of uncertainty.

If students are overwhelmed, the level of difficulty must be reduced. The two most important options: (1) filling gaps in prior knowledge (2) updating prior knowledge.

The two distinctions between problem types – degree of uncertainty and learning objective level – can be related to each other to provide learners with a differentiated system that enables them to apply the 'task' method both intuitively and reflectively.

PBL Blueprinting Toolbox
Rudnicki, A., Buck, E., & Morey, O. (2015).

Linking problem types:

degree of uncertainty / learning objective level	Interpolation problems	Discovery or structuring problems	Dialectical problems
Explanation problems			
Transfer problems			
Analysis problems			
Design problems			
Assessment problems			

Sources
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