Problem-Based Learning:
What, Why and How

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What come to your mind…?

Problem-Based Learning:
What

- A learning/teaching methodology based on the principle of using problems as a starting point for the acquisition of new knowledge.

- A learning/teaching methodology designed to create learning through experience and the reinforcement of existing knowledge.

Source: Lambros, A (2008). At a workshop in SEAMEO RECSAM

PBL: **Characteristics**

- Problems are "real world" in nature for the learners: they can see the need to know the information in their future.

- Problems activate prior knowledge: learners are able to "hook" new content on some existing experience or information.

- Problems mimic ways in which new information will be applied later: either in assessment or practice.

In a nutshell: PBL

It is a student-centered pedagogy in which students learn about a subject through the experience of solving an open-ended problem

History

- The PBL format originated from the medical school

- It was developed at the McMaster University Medical School in Canada

- in the 1960s and has since spread around the world.

PBL: **Philosophy**

- Learners prefer to participate in decision-making about their learning.
- Learners bring lots of information to new learning (no blank slates here).
- PBL reinforces existing knowledge and creates a starting point for acquiring new content.
- PBL problems enhance the integration of new information.

PBL is a constructivist approach…

- (Learning through the process of inquiry and constructivism)

- A constructivist approach to instruction,

- emphasizing collaborative,

- and self-directed learning;

- and being supported by flexible teacher scaffolding

Roles of learners and instructor

- Learners (Students)
- Working in groups,
- identify what they already know,
- what they need to know, and
- how and where to access new information (that may lead to the resolution of the problem).
- Instructor (tutor, teacher?)
- to facilitate learning
- by supporting, guiding, and monitoring the learning process.

Learning is Self Teaching

"The Teacher's part, then, in the process of instruction is that of a guide, director or superintendent of the operations by which the pupil teaches himself."

Joseph Payne, 1883
Lectures on the Science and Art of Education

Consider the last new thing you learned…

- It is likely you chose what to learn.
- It is likely you were driven by interest or need.
- It is likely you chose a variety of resources.
- It is likely you discussed the subject with someone.
- It is likely you integrated the new information with something you already knew.

Here Is What We Want To Have Happened

Create learners who:

- Know what they know with confidence
- Know what they do not know with confidence
- Can effectively and efficiently access new information and integrate it with existing knowledge
- Apply the new information to problem resolution

Summary: PBL (what)

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Problem
-real-world
-open
-PS sills

Experience
-old + new knowlegge
-contructivist

Small group
Student centred
Process not outcome wanted

Summary: PBL (what)

(Barrows defines the Problem-Based Learning Model)

1. Student Centered Learning
2. Learning is done in small student groups (ideally 6-10 people)
3. Facilitators or Tutors guide the students rather than teach
4. A Problem forms the basis for the organized focus of the group, and stimulates learning
5. The problem is a vehicle for the development of problem solving skills. It stimulates the cognitive process.
6. New knowledge is obtained through Self-Directed Learning (SDL), building from prior knowledge
7. *Process, rather than outcome is considered more important in this learning process.*

PBL: Why

- The learning is relevant
- The learning is more retrievable
- The learner can apply the learning in similar situations
- The learning is long-term and embedded rather than dependent on rote recall
- The learning is more exciting and more fun (true? example?)

PBL: Why

- The learning emphasizes meaning rather than fact accumulation

- Higher retention of learning

- Deeper understanding of learning

- Development of interpersonal, collaboration, and negotiation skills (small group activity?)

- Development of life-long learning skills (thro' real life/authentic PS!)

At the End of the Day…

- Students know what they know with confidence

- Students can identify what they do not know/need to know

- Students can efficiently and effectively acquire new information, integrate it with existing knowledge, use it to move towards problem resolution

Why is PBL good … (you tell us why…)
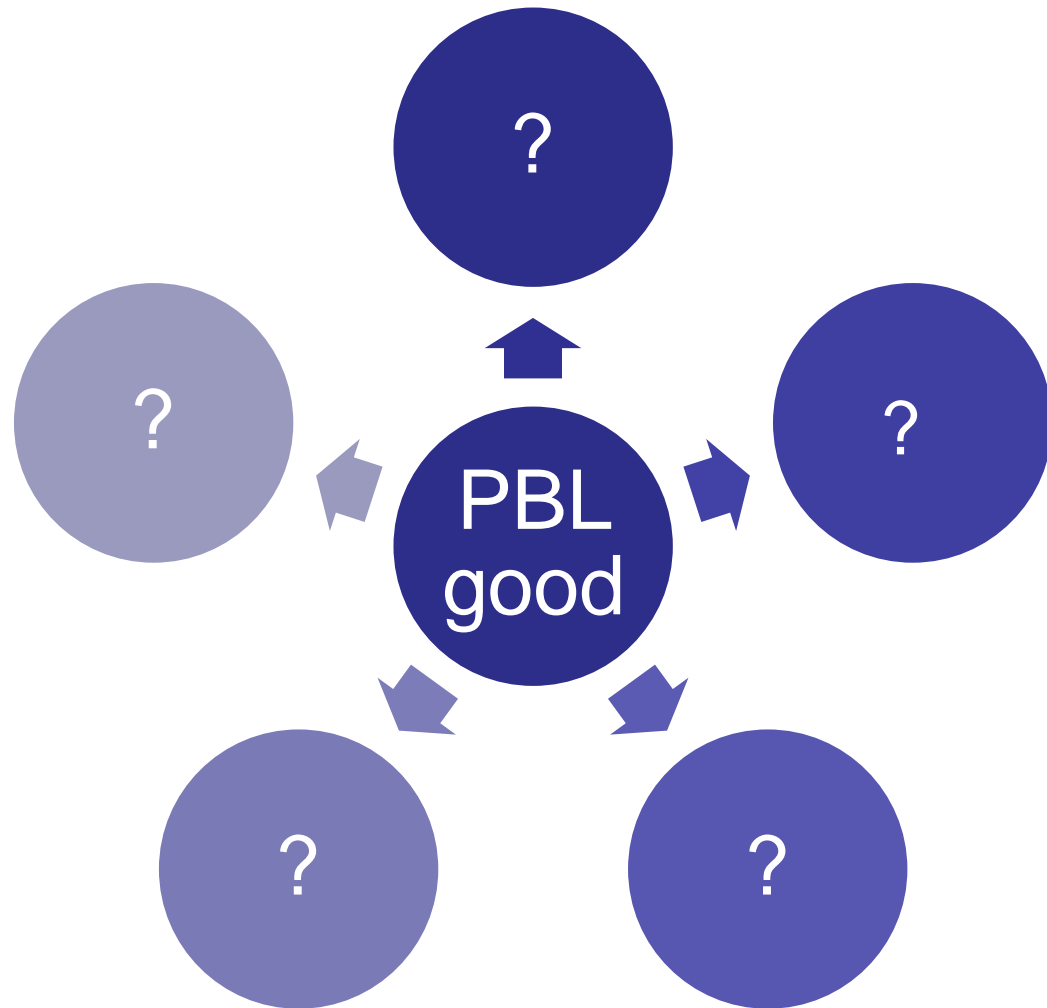
PBL good because… (why)

- It can be used to enhance content knowledge
- fostering the development of communication, problem-solving, critical thinking, collaboration, and self-directed learning skills.
- students in a simulated real world working on professional context (which involves policy, process, and ethical problems that will need to be understood and resolved before arriving at an outcome).
- students learn to negotiate the complex sociological nature of the problem and how competing resolutions may inform decision-making
- (by working through a combination of learning strategies to discover the nature of a problem, understanding the constraints and options to its resolution, defining the input variables, and understanding the viewpoints involved)

How? (the process)

(Timeframe: This lesson plan will take approximately 4 hours.)

Step-by-step guide

1 Put students into teams of three to five members.

2 Ask for a volunteer to read the STUDENT PROBLEM aloud

3 As a whole group, ask students to list What We Know

4 Have each team create a list of What We Need to Know
   [NEED-TO- KNOWS & LEARNING ISSUES].

5 Have each team begin a list of POSSIBLE HYPOTHESES

6 Provide ADDITIONAL INFORMATION for NEED-TO-KNOWS, allow teams to research LEARNING ISSUES

7 Teams re-evaluate POSSIBLE HYPOTHESES and determine one DEFENDABLE SOLUTION for Final Product

8 Teams create and present DEFENDABLE SOLUTION and individual students write ACTION PLAN

Student Problem

(FOR STUDENT USE)

It is the year 2075. You are a member of Newtown Council in Wonderland, a small country near Kenya. Flying cars are now a reality - but without roads to guide traffic, accidents have increased 500% since the year 2000. Also, since cars fly 100 meters off of the ground, traffic fatalities occur in 90% of accidents.

The Prime Minister of Wonderland has proposed outlawing flying cars. Alternatively, he wishes to design an infrastructure of tracks on which all vehicles would operate.

The Minister of Transport disagrees - she believes that flying cars simply need new safety features!

Your council has been asked to file a report for both proposals.

(Source: Adapted from Wake Forest School of Medicine Problem-Based Learning)

Based on Student Problem 2:

Steps to do 'How'

- Step1 : Read scenario aloud
- Step 2: (a) Identify problem
-              (b) Desired solution
-              (C) Science principles

applicable

Write and display (a), (b) & (c).

Step 3 : **What We Know**

- List the points / key facts
- Display points

Key Facts (FOR FACILITATOR USE ONLY)

- Newtown Council

- It is the year 2075.

- You are a member of Newtown Council in Wonderland.

- Flying cars are now a reality.

- Without roads to guide traffic, accidents have increased 500% since the year 2000.

- Traffic fatalities occur in 90% of accidents.

- The Prime Minister of Wonderland wants to (i) outlaw flying cars or (ii) design an infrastructure of tracks on which all vehicles would operate.

- The Minister of Transport disagrees , she believes that (equipped) with new safety features, the flying cars will be fine.

- Science principles involved?

Step 4: What we need to know (the learning issues)

• Discuss, list & display

Need-to-knows / Learning Issues

FOR FACILITATOR USE ONLY

NEED TO KNOWS	NEED TO KNOW ANSWERS
What, specifically, is the Prime Minister of Wonderland's proposal? What, specifically, is the Minister of Transport's proposal?	Provide teams with the Additional Information for Students
LEARNING ISSUES Would collisions be less dangerous on tracks? How could we make flying cars safer? What are Newton's Laws of Motion?	**LEARNING ISSUE RESOURCES** Students will investigate using the Learning Issue Resource Guide

Soursea: Wake Forest School of Medicine Problem-Based Learning

Step 5: **Hypothesize**

- List possible hypotheses
- Display

Hypotheses

FOR FACILITATOR USE ONLY

- Hypotheses will vary by the recommendations that teams make for suggested speed limits and how to address intersections if they support the Prime Minister of Wonderland proposal.

- Hypotheses will vary by safety feature recommendations if they support the Minister for the Department of Travel's proposal.

Step 6: Additional info?

- Any additional info available?

Additional Information

- **Prime Minister of Wonderland Proposal:**

- "Flying cars are too dangerous! What we need are tracks along which our vehicles can travel - that way, cars can't crash into each other. I propose that we build tracks between all major cities in Wonderland. Cars can hook onto the track and I think we could safely allow them to travel at 240 km/h. I guess at intersections they could slow down to 90 km/h. How bad could a crash be at that speed?

- I guess I haven't worked out all the details. However, our Newtown Council studies all things related to motion, and they are working hard on a report! I know they can solve our traffic problems by designing a system of tracks."

Additional Information

FOR STUDENT USE

- **Minister of Transport's Proposal:**

- "Flying cars can be perfectly safe with the right safety precautions! They just need some kind of force field to surround them that prevents other cars from hitting them. Perhaps some kind of wrapping to reduce the impact would work?

- I suppose I haven't worked out all the details either, but our Newtown Council studies all things related to motion, and they are working hard on a report! I know they can solve our traffic problems by making flying cars safer!"

Additional Information

FOR FACILITATOR USE ONLY

- Present teams with the Student Problem.

- Teams will list facts and need to knows.

- Ensure that each team asks what each proposal contains.

- Provide teams with each proposal. After reading the proposals, teams will be ready to research Learning Issues related to forces and interactions.

- Provide resources listed on the Learning Issue Resource Guide.

- Teams should now decide whose proposal they will support and begin to generate hypotheses.

- Teams may support the Prime Minister of Wonderland proposal. They must suggest possible speed limits and address how to regulate intersections.

- Teams may support the Minister for the Department of Travel's proposal. They must make safety feature recommendations.

Step 7 : **Decide on a most possible hypothesis**

Step 8: Research on most defendable solution as final product

Learning Issue Resource Guide
FOR FACILITATOR USE ONLY

- **WEBSITES**
- The Science Channel TM: Laws of Motion **www.sciencechannel.com/gamesandinteractives/newtons-lawsofmotion-interactive.htm**
- Make Me GeniusTM: Laws of Motion **www.makemegenius.com/video_play.php?id=175&type=0**

- **TEXT RESOURCES**
- Sir Isaac Newton: Using the Laws of Motion to Solve Problems by Kerri O'Donnell
- Eyewitness: Force & Motion by Peter Lafferty
- Physics textbooks

Step 9: Final Product and Writing Guide

FOR FACILITATOR USE ONLY

- # Team

- Each team will make a presentation to the ministers stating which proposal they endorse and provide supporting evidence.

- # Individual

- Each student will write a report to be released to the public outlining the problem, both proposals, and the proposal they endorsed with an overview of their findings.

(Step 10) **Rubric**
FOR FACILITATOR USE ONLY

AREA	ABOVE AVERAGE Three points each	AVERAGE Two points each	BELOW AVERAGE One point each	NO EVIDENCE Zero points each	POINTS
Final Product	• All Learning Issues addressed • Three or more hypotheses present • High quality final product	• Most Learning Issues addressed • Two hypotheses present • Roles somewhat defined • Fair quality final product	• Few learning issues addressed • One hypothesis present • Low quality final product	• No learning issues addressed • No hypotheses present • No final product	
Writing Assessment	• Problem Summary, Learning Issues/New Information Integrated well presented • Hypotheses well presented • Solution and Defense well presented	• Problem Summary, Learning Issues/New Information Integrated presented • Hypotheses presented • Solution and Defense presented	• Problem Summary, Learning Issues/New Information Integrated poorly presented • Hypotheses poorly presented • Solution and Defense poorly presented	• Problem Summary, Learning Issues/New Information Integrated not presented • Hypotheses not presented • Solution and Defense not presented	
Collaboration	• Individual works well with group members • Individual communicates well with group members • Individual carries out their individual responsibilities	• Individual works acceptably with group members • Individual communicates acceptably with group • Individual mostly carries out their individual responsibilities	• Individual does not work well with group members • Individual does not communicate well with group members • Individual attempts but fails to carry out their individual responsibilities	• Individual interferes with group members • Individual does not communicate at all • Individual does not attempt to carry out their individual responsibilities	

24 – 27 Points – Above Average   15 – 23 – Average   6 – 14 – Below Average   0 – 6 – Failing

Thank you