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Problem Based Learning 4

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Title: Problem Based Learning

Lecturer: Robert Howard

Programme and year on which assessment was offered

Physics Programmes

Description

Assessment criteria for teaching groups through PBL.

Learning Outcomes

Assessment group work process (not product) is used to develop group skills and develop and understanding subject (physics) concepts.

What have you found are the advantages of using this form of assessment?

- very good attendance as student is assessed in every class
- timely feedback is part of assessment process
- assessment mark is for each individual student

What have you found are the dis-advantages of using this form of assessment?

- Difficult to accurately assess individual students if group size is greater than 4-5. Especially if you are assessing 3 groups at a time (roaming tutor).
- A lot of time spent by tutor giving feedback (2 hours per week) and correcting reports (1.5 to 2 hours per week)
- Resource intensive 45 students means 9 groups, 3 tutors (3 groups each), and 3 rooms with flexible furniture.

Alternatives

You could just assess the product (the answer or the report) but this tends to reward lazy students and means the hard working student must work harder.

Assessment in practice

Resource intensive for large groups: 45 students means 9 groups, 3 tutors (3 groups each), and 3 rooms with flexible furniture.

Assessment time

- Preparation time (lecturer): Writing PBL problem must be written to cover module: easily ½ or 1 day per problem. But best done in a team. Could need 8 to 12 problems per semester.
- Student time to complete: 2 x 2 hour sessions (or 1 +2 hours sessions) in class. Self study about 2-4 hours
- Marking time: 3-4 hours per week.

- Ease of Feedback : Easy but time consuming.: Write a short paragraph with score then email it to the student.

Additional Resources

Assessment Form

Problem: Group:

Tutor:

Name	Date	Date
	• Actions • Working towards understanding • Peer tutoring • Assisting group focus • Big Picture • Response to feedback	
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	• Actions • Working towards understanding • Peer tutoring • Assisting group focus • Big Picture • Response to feedback	

PBL in class assessment criteria

Contribution

The role of the every group member is to contribute to the group process and be responsible for group maintenance. The level of contribution can be evaluated and assessed against the following aspects of an individual's role within a group:

- **Actions**

The chair of the group can delegate tasks to individual members during the group process. Alternatively a group member may volunteer for a specific task. It is then the group member's responsibility to complete this task to the best of their ability and report back to the group. The group can expect the task to be completed on time and in full.

- **Working towards Understanding**

It is each member's responsibility to strive towards a complete understanding of the physics involved in each problem. It is not sufficient to just sit back and listen in the hope of learning something later but you must be actively engaged in the process and trying to understand the physics. This can be accomplished by regularly asking other group members questions, stating what you understand to be correct, summarising the groups' position, looking for mistakes in the process, thinking and calculations, and ensuring you understand the other group members.

- **Working towards Group Understanding**

One of the aims of the process is that by the end of a problem the group has achieved the same level of understanding. Each group member can promote the group learning by continuously asking each other questions to ensure everyone understands.

- **Peer Tutoring**

In many cases some of the group members will have a greater prior knowledge of the subject matter. In this situation it is their responsibility to help the other students learn by explaining and teaching the physics involved. In this way the students can learn from each other and also by teaching the subject the students with prior knowledge can identify any holes in their understanding.

- **Assisting Group Focus**

It is each members responsibility to help keep the group focused on the problem and to maintain a good group working environment.

- **Big Picture**

It is important to the process for each member to remain focussed on the overall objective of the problem and not to get distracted by small and maybe irrelevant elements.

Response to Feedback

You will be given feedback from your tutor every week. The feedback is to help you to improve both your physics and group skills. You are expected to log on to webcourse and check your tutor feedback between problems. You are assessed on how you respond to your feedback, if you follow the tutor's advice your marks will improve, if you ignore their advice your mark will go down. If you feel that the feedback is unjust or unclear please talk to the tutor and clarify it.

Suggested Guidelines for working through a PBL physics problem

Level 8. 4 Hours (2 sessions)

Time	Students' Actions
Session 1 Tuesday 2-4 pm	• Read the problem individually • One of you reads it out loud • No books or notes are needed in the first session. • Put up flip charts – **6 Spaces** • **Ideas** – Brainstorm, each student gives at least one idea. Write up every idea, even if you're not sure if it is correct. Don't rule any idea out just yet, they may stimulate other ideas • **Facts** – write up the facts from the problem • **Diagram** – to summarize the situation • **Learning Issues** – identify what you need to learn to solve this problem. It may be physics, equations or concepts or it may be just getting a piece of information. • **Plan** – What is the crux of the problem? What are the steps you must take to solve it? Depending on the problem you may have enough information to start solving the early stages of the problem. Or else you can plan the problem based on assuming values for the missing information. You can then look up the information between classes. • **Tasks** – Each of you write your name beside a task which you will study and research. • You must bring in a hand written **summary sheet** of your learning issue. A typical summary sheet contains, a definition, an example to explain it, the relevant equation, a worked example of the equation, ideas of how this will help them with the PBL problem
Between classes	You study your assigned tasks. You need to read the topic, think about it and write summary notes. It is not enough to have a list of definitions and equations, you should understand what the words mean and be able to explain them. Think about the equations, 'What would happen if I changed that variable?' You should think 'How will I

	explain this to my group?' 'What is the best way to explain it in my own words?' **(This is what you get a lot of marks for)**
Session 2 Thursday 2-4pm **Phase 1** First half hour	• Flip Charts up • **Peer tutoring:** Using your *summary notes* as a guide, each of you takes your turn to get up to the flip chart and peer tutor what you have researched. • The other students ask questions to make sure that they understand it and can explain it themselves.
Phase 2 Rest of the time	• **Solution:** Once all the group members have covered all their LIs then you can get on with applying this knowledge to solving the problem. • **Plan**: You should write up your plan. 'What is the crux of the problem? 'What are the main steps?' Then divide the main steps in to sub-steps. • **Calculations:** This is all done on the flip charts. Each group member needs to be able to follow the solution and be able to explain what is happening at any time. Everyone should double check all the calculation. You are all responsible for what goes up on the flip chart. • **Answer**: Think about the answer, does it make sense or seem reasonable, is it too big or too small?
Between problems	Read your feedback. Think about it. Decide how you will improve, and what actions you should take to improve.

Teaching Methods.

Problem Based Learning: PBL was developed in the 1970s by Harold Barrows (Barrows, 1986) in M^{c}Masters University, Canada. It was first used to teach medical students and has since been introduced into other disciplines, such as English literature (Hutchings and O'Rourke, 2004). It was first used in physics in Ireland in DIT's DT222 level 8 physics course in 2001(Bowe and Cowan, 2004).

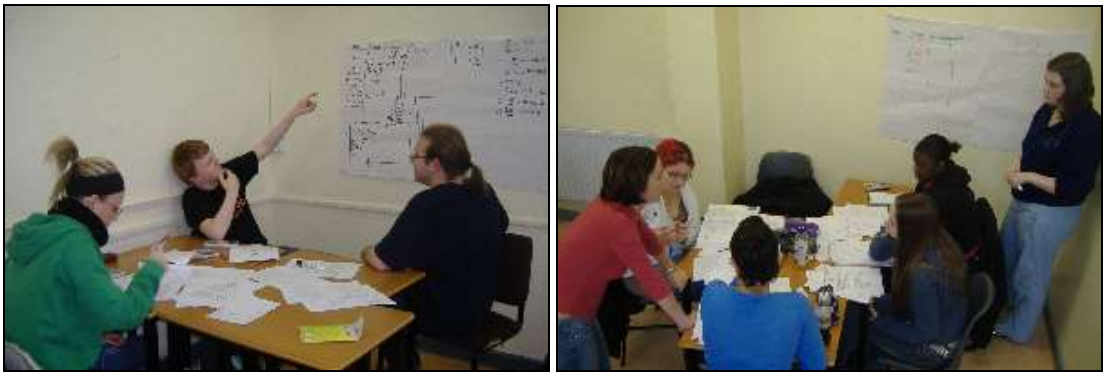

Figure 1: Photographs of first year physics students learning in groups

(more photos in appendix C)

PBL is based on the fact that students learn by exploration. The students work in small groups of about five, and are given a problem or scenario, which they have never seen before. The problems are written as to be open-ended and have information omitted. The students must make assumptions, approximations and retrieve information. It is by working though the problem, group discussion, self-study and peer tutoring that they learn new physics ideas, concepts and skills, as well as group, leadership, problem solving and self-study skills.

Examples of physics PBL problems.

Problem 1: **Caveman Stew**

Early inhabitants of Ireland developed a way of boiling water even though they had no pots or other utensils for cooking food in. They did this by digging a pit, which they lined with rocks. They filled the pit with water and then had to devise a way of bringing the water to boil in order to cook the meat, which they would place in the pit. What they did was to heat rocks in a fire and place the rocks in the water until it reached a sufficiently high temperature.

You are part of a team that works for the Irish National Heritage Park in Ferrycarrig, Co. Wexford, and your manager has instructed you the park wishes to re-enact this prehistoric method of cooking. You will need to work out the physics of the procedure. Your manager has told you that due to the space available, the pit should have the following dimensions: 1 m x 1 m x 3 m. She has also done a little research herself and has told you that the rocks available are a mixture of hard and soft rock, which on average can be heated to around 360°.

	Hard rock	Soft rock
Density (x 10^3 kg/m^3)	2.67	2.2
Specific Heat Capacity (x 10^3 J/kg° C)	1.0	1.4
Thermal conductivity (W/m° C)	2.8	2.2

Problem 2: Nicolet Ltd

You work for Nicolet a world leader in spectrometer manufacturing. You have been asked to design the layout of their new visible absorption spectrometer. The plan is to use a tungsten lamp as the white light source. The detector is a 1000 element linear array (dimensions 10mm x 2 mm). Your team have to select the diffraction grating and design the bench layout for the source, sample holder, diffraction grating and detector. You must determine the angles between the components and the overall layout of the final spectrometer. The wavelength range of the spectrometer is 400 nm to 800 nm with a resolution of at least 0.5nm.

Problem: P2 Smart Car
Tutor Name : Laura Walsh
Marks: 6/10

You did better in the second problem and explained some of the physics related to the problem. Your group needs to work towards an understanding together, be more vocal by explaining your understanding and asking the other members of the group to explain theirs. However you are doing well and are obviously interested in learning, keep it up.

Problem: P3 NukeWaste Train
Tutor Name : Laura Walsh
Marks: 6/10

You and your group did much better in the third problem, you put effort into both solving the problem and attempting to understand it yourself. You explained your understanding to other group members and put forward valuable ideas. However your group tended to focus on the solution rather than the concepts involved and therefore made mistakes. If you (as a group) continually summarise your understanding and progress through the problem, you will find that this happens less often.

Problem: P5 Crash Investigation
Tutor Name : Laura Walsh
Marks: 5/10

You contributed to the process by putting forward some ideas, however you must be more confident about your physics knowledge. Unless you speak up, not only will the group suffer but you will not be able to identify any holes in your understanding. You also need to study more (hand write some notes) between classes and not just live on what you know already.

References

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