What is PBL?

Problem Based Learning in Electronic and Electrical Engineering

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Session Outline

• Some background to the PBL project
• Exploration of traditional teaching vs. student-centred learning
• The Communication Systems II course
• Findings from the first year
• Any questions…
The PBL Project

• IEE Industry Course Working Party – reported a growing dissatisfaction with graduates' professional skills
• Association of Graduate Recruiters – the need for university teaching to move from teaching knowledge to enabling learning
• Industry felt that academia should produce graduates with
  – Relevant problem-solving skills (74% want problem solvers)
  – The ability to continue to learn throughout their careers (77% want graduates who know how to learn)
• Current graduates had knowledge but not always these skills

The Partners

• HEFCE Funding
• First course using PBL started in September 2004
Views on traditional teaching

• Thinking back to a course you took this year, how did you learn best?
  – Lectures
  – Lecture notes
  – Tutorials
  – Problem sheets
  – Past exam papers
  – General reading around the subject

Views on traditional teaching

• Looking at the list of learning methods, make notes of the benefits and drawbacks of these features.
• Which methods were most effective?
• Which do you enjoy least?
Students’ perceptions

• What do you think of lectures?
• What other students said about lectures:
  – Boring
  – Lack of concentration
  – Pace (too fast *or* too slow)
  – Class size and noise distracting
  – Class size makes it intimidating to ask/answer questions
  – Not interactive

"Students need time to make sense of material for themselves... An unfortunate result of spoon-feeding students is the amount of regurgitated material that appears during exams. By letting students learn for themselves, they may digest it more thoroughly."

Dr Holly Smith,
Times Higher Education Supplement, 27/02/04
So what is PBL?

• In small groups, discuss what you think PBL might involve and make a list of these features
• As before, make a list of what you think are the benefits and drawbacks of this approach to learning

So what is PBL?

• It’s easiest to think about it as a reversal of the normal teaching process, ie:
  – No longer lecture -> exam, but problem -> solution
• You will work in groups, on real problems
• You will explore the problem area using a variety of approaches and sources
• You will get feedback on work in progress
• You will be assessed on how well your solution fits the problem
• You will reflect on your own and your group’s learning process to improve performance on the next problem
Example Problem

• You are given 2 AAA (1.5V) Batteries and a 6 volt bulb with a rating of 60mA.
• When connected together, how long will the bulb stay lit?

Do you have all the information you need to solve this?

Capacity of a AAA = 1200mA/h

A Solution

6v bulb rated at 60mA \( \Rightarrow R = \frac{6}{60} \text{mA} = 100\Omega \)

When 3V is applied the current will be

\[ \frac{3}{100} = 30\text{mA} \]

If the battery has a capacity of 1200 mA/h

The light will glow for \( \frac{1200}{30} = 40\text{h} \)
This is not the only way to connect the bulb.

6v bulb rated at 60mA \( \Rightarrow R = \frac{6}{60} = 100 \Omega \)

When 1.5V is applied the current is

\[ \frac{1.5}{100} = 15 \text{mA} \]

In parallel the batteries have a capacity of 2400 mA/h.

The light will glow for \( \frac{2400}{15} = 160 \text{h} \)

**But will the bulb still light?**

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**But .....**

- Is the resistance of the filament really constant?

\[ V = IR \]

What if the resistance is dependent on the temperature?
Communications Systems II:
Core Syllabus

- Practical Wireless Systems
  - Radio propagation
  - Noise in radio systems
- Digital Transmission
  - Sampling, quantisation, TDM
  - Digital signals, signal design, noise, inter-symbol interference, error coding
  - Digital modulation
- Optical Communications Systems
  - Fibre principles
  - Detectors and receivers
  - Optical systems design
Communications Systems II: Key Skills

- Ability to specify search criteria for scientific/engineering literature, evaluate the information, synthesise into a clear and concise report
- Ability to analyse, synthesise and evaluate specification documents and component datasheets
- Ability to analyse specification documents and follow good practice in engineering design to create a prototype
- Criticality
  - Working with incomplete information
- Creativity
  - Innovative solutions
- Problem-solving
  - Locating and reframing problems in the wider context
- Academic development
  - Oral/written communication, information handling skills
- Personal and professional development
  - Team work, time management, collaboration

Communications Systems II: Structure and Assessment

- Structured around a series of four problems
- Developing engineering knowledge and key skills in context
- Assessed by portfolio:
  - A solution to each problem – written reports and presentations (group products)
  - An individual report focusing on what you did and what you would do differently – process
  - Short Viva
Facilities

Department of Electronic and Electrical Engineering

How to solve a Problem
Solving a Problem

We can map out the stages we would hope a student would go through to answer the problem that is being set.

Redefine the Problem
Identify Key Concepts
Identify Sources
Evaluate and Discuss
Brainstorm
Test

Yes
Solution

However, this is not always followed!

Redefine the Problem
Identify Key Concepts
Identify Sources
Evaluate and Discuss
Brainstorm
Test

Find Information
Forget Problem
Is it 4:55 already?

With experience students became better at 'understanding' the problem. This came from much experience in earlier problems of going down deadends.

"This report looks very much like an encyclopaedia of radio terms (except that it is not in alphabetical order! )"

Feedback to group for problem 1
Assessors commented that much of the design was not justified.

“I wouldn't use Google or any other service because the data is not reliable whereas Athens lets you search among the data that is published by reliable sources.”
Results

• Students on the whole found it enjoyable

"If you’re sitting in a classroom learning something it’s because there’ll be a question on that in the exam, in this, you can do things to research, it was nicer to think it through for oneself, thinking this is the way to do it… but it proved much harder…"

• Felt it taught them new skills; problem solving, literature searching, team work

"More life skills than academic knowledge, how to work in a group, how to lead, how to work under people and how to research, that's a lot better."
Results - Observations

• Problem solving skills visibly improved
• Learnt to brainstorm
• Use of whiteboard to capture the problem increase in later problems

Concerns

• It is hard work
• People do not get good marks from the course
• It takes up time that you should spend on your project

"That’s because people wanted to do the work, they felt it was an opportunity for them to take something out of the course. They wanted to do the work, rather than feeling they had to do it."
PBL performance 2004/05

Project Marks 2004/05

PBL performance 2004/05 and 2005/06

PBL Marks

Pass 3 2:2 2:1 1
What to remember

- It takes more of time.
  - But there is no revision and no exams
  - Work is spread evenly over the term
- Making the group work is important
- It teaches skills that most employers are looking for in CVs

Common Application form Questions

- “Describe a situation where you had to work effectively as a member of a team. What was the team’s aim? How was the team selected? What was your role?” (KPMG management consultants)
- “Think of an occasion when you were required to explain something complex to two or more people who were unknowledgeable on the subject.” (Oracle Corporation)
What to remember

• The course will start the very first day of term
• Once signed up it will not be possible to drop out of the course

Any questions?