

Introduction to Problem-Based Learning



A workshop at
Yuan Ze University

January 14-15, 2008

Facilitated by
Mark A. Serva and George H. Watson



Institute for Transforming
Undergraduate Education



University of Delaware

Handouts for Day 2

PORTAL SYSTEMS: STAGE 3

Return to your original group. Your group will assist Dan by formulating the final recommendations for Amy Smith. Your recommendations should be in the form of a 5 minute PowerPoint Presentation and should answer the following focus questions:

- Should Portal Systems offshore its customer service function?
- If so, how much? How can it complete the transition as painlessly as possible? What are the future implications of offshoring its call centers?
- If not, what are Portal Systems alternatives to offshoring? What are the advantages and disadvantages?
- How can Portal Systems balance the concerns of its stakeholders?

What Is a Good PBL Problem?



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Good PBL Problems...

- relate to real world, motivate students
- require decision-making or judgments
- are multi-page, multi-stage
- are designed for group-solving
- pose open-ended initial questions that encourage discussion
- incorporate course content objectives, higher order thinking, other skills



Rubric to Evaluate PBL Problems

| Criteria | Descriptors | | |
|-------------------|--|---|---|
| | 3 | 2 | 1 |
| Realism | Based on an actual or fictionalized real-world situation linking topic to learner. | Contrived or contains unrealistic elements that decrease credibility. | Unrealistic, lacking relevant context. |
| Content | Addresses significant conceptual issues; directly related to major content goals. | Encourages superficial rather than in-depth understanding concepts. | Relevance of topic peripheral or not apparent. |
| Engagement | Stimulates discussion and inquiry through its relevance and presentation. | Generates limited or superficial discussion; provokes little curiosity. | Lacks a "hook"; obscure or pedantic presentation. |



Rubric to Evaluate PBL Problems

| Criteria | Descriptors | | |
|-------------------|---|--|---|
| | 3 | 2 | 1 |
| Complexity | Appropriately challenging; group effort and cooperation required; some ambiguity appropriate; integrates multiple concepts. | Difficult but may encourage a "divide and conquer" approach. Concepts not well integrated. | Solution accessible to most students working alone; focused on single concept. |
| Resolution | Open to multiple resolutions or multiple pathways to solution, depending on student assumptions and reasoned arguments. | Resolution is more obvious but allows reasonable opportunity for judgment and discussion. | One right answer is expected; limited opportunity for analysis and decision making. |



Rubric to Evaluate PBL Problems

| Criteria | Descriptors | | |
|------------------|---|--|--|
| | 3 | 2 | 1 |
| Structure | Progressive disclosure via multiple stages, builds on existing student knowledge. | Staging does not flow well; transition could be improved. | Too much or too little information provided at once; short cuts thinking/research. |
| Questions | Limited in number, short, and open-ended; encourage deeper understanding. | Most are directive; preempt student-generated learning issues. | Lead to "yes-no" answers rather than thoughtful discussion. |
| Research | Promotes substantive research using multiple resources. | Research limited to textbook material. | Limited necessity for research. |



Take a few minutes in your group to discuss the problem you have just experienced: what are the strengths and weaknesses of this problem?

Take a few minutes in your group to apply the rubric to this problem.

Rubric to Evaluate PBL Problems

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Other possible rubrics:
Problem Delivery and Process
Associated Assignments
Student Products and Presentations

Writing Effective PBL Problems

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Important Considerations in Writing Problems

- Role of problem in accomplishing course objectives
- Level of course and maturity of students
- Time frame
- Staging
- Availability and access to learning resources
- Use of prompting questions





Types of Learning Objectives

- Content-oriented:** subject specific
- Basic knowledge and understanding of specific concepts, techniques, etc. in the discipline
- Process-oriented:** global skills
- Effective communication: oral and written
 - Acquiring and evaluating information
 - Working effectively with others
 - Higher order, critical thinking



What Factors Influence Decisions about Problems?

Your background

- discipline
- control issues
- level of investment

What is the course?

- students (number and level)
- sequencing of course/problems
- time/structure of class





Step One: Identify Learning Objectives

Think of a learning objective in your course:

- CONTENT: "My students will understand the management issues that occur when you monitor your employees."
- PROCESS: "My students will improve their understanding of the process of management decision-making."
- PROCESS: "My students will improve their memo-writing abilities."

How do you usually address this learning objective? What kind of problem or activity do you usually assign?

- Typical end-of-chapter problem?
- A reading?
- Other?



Step Two: Identify Real-World Context

- Newspaper articles, news events
- Real event that you experienced
- Popular press in the discipline
- Make up a story – based on content objectives
- Adapt a textbook problem
- Research papers
- Other?



Take 15 minutes to read through
Stage 1 of the Ever-Ready Security Case

You and your team should briefly discuss
the focus questions



Textbook Problem/Concept



"The secretarial pool is part of the group assigned to Doug. The pool has produced very low quality work for the past several months. Doug has access to the passwords for each of the pool members' computer accounts. He instructs the supervisor to go into each hard drive after hours and obtain a sample document to check for quality control."

If you were the supervisor, what would you do? Is this ethical?"

Pearlson and Saunders (2006), *Managing and Using Information Systems*, John Wiley & Sons, p. 211.



A Real Life Scenario: Ever-Ready

- Based on my wife's experiences
- "You can't make this stuff up"
- Information given gradually throughout problem



Step Three: Draft the problem

- Add context by creating a realistic application of the concept.
- Be a storyteller: Add motivation, realistic characters
- Require students to go beyond memorization by researching ambiguous situations
- Require them to make a decision and defend it: what would YOU do as a manager?
- Reinforce that decision-making is not easy by making the situation ambiguous



Drafting the Problem (cont.)

- Good PBL problem has multi-page, multi-stage construction - leave students guessing!
- Not all information should be given in chapter or text—have students do outside research.
- Challenge students to come to consensus, reach conclusions, and make judgments, deal with ambiguity



Staging of the Ever-Ready Case

Stage 1: Judging if a problem exists. What information does Harry need before he can take action?

Stage 2: More information given. "Surprise" (and open-ended) conclusion. Students need to make further judgment calls



Activities Related to Ever-Ready

- Groups summarize each stage before moving to next.
- Final stage written up by group with complete analysis.





Mixing in Process Objectives with Content Objectives

Public-speaking: Groups present their approach before moving to the next stage.

Memo-writing: Final deliverable is the writing of a memo that presents their decision and logic behind it.

Research: Teams are required to find evidence to support their conclusions.



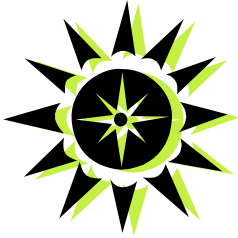
Teamwork: Students must learn to work together to solve the problem.



Get Started Writing Your Own Problem

- During lunch, think about a problem that you often use in a class
- Using the suggestions in this presentation, think about how that problem could be adopted as a PBL problem
- Bounce ideas off of colleagues!
- Be prepared to write your first PBL problem after lunch
- Feel free to reorganize into teams that reflect your general academic disciplines.

Ever-Ready Security Stage 1: An Awakening Problem?



"Harry, we've got a problem here."

The phone call had come from Dennis, the Operations Director at Harley-Davidson's parts storage facility. Dennis continued, "this is the *second* time I've found spray paint on the back of the building—and not just one bad word, Harry. I'm talking about a really detailed, multicolored little portrait by some kid who thinks he's an artist. Your man Steve must have been sleeping on the job."

Harry took a deep breath. He was the Director of On-Site Services for Ever-Ready, the company that handled security at Harley-Davidson's manufacturing plant. Harley-Davidson manufactured motorcycles: Ever-Ready's guards were supposed to patrol the site, verify that the entrances were secured, and report any unusual activity to management and the local police or fire station, if necessary. Steve was supposed to make one loop around the site each hour, from dusk until the first shift reported in the morning.

Harry asked, "You're sure the spray paint wasn't there before Steve's shift started that night?"

"I'm positive. A couple of nights ago, when I entered the building unannounced, I'm positive that Steve had just woken up from a little nap in his chair. Listen, I'm going to give you a few days to figure this out. But for your sake and mine, I'd better not see any more sleepy-eyed security guards."

"Dennis, thank you for alerting me. I'm sorry to hear you've had a problem with security, and I promise to do whatever is necessary to ensure that it doesn't happen again." He hung up, feeling a little nervous: Harley-Davidson was Ever-Ready's biggest client, and he could afford to lose its contract.

Harry called Steve at work that Thursday night. Steve acknowledged not seeing the spray paint, and apologized for not reporting the incident. But he said, "That location is in a really dark area in the back of the building, by the loading dock. There is no lighting. So I doubt I would have seen it even if I were looking for it. Not to mention the garbage cans and pallets back there... whoever did it could have hidden right behind them while I walked around. I told Dennis that I'm going to check out those areas from now on when I walk around. Really—I've got a handle on it, Harry. It's definitely not going to happen again."

Focus Questions

1. (Work individually). Assume you are Harry and you just talked to Steve. What information do you know? What information do you need to know? How can you get this information?

2. (Work as a team). How would you handle Dennis' concerns? What actions—if any—would you take with Steve?

**Ever-Ready Security:
Stage 2: An Increasingly Candid Situation**



The next Monday evening, Harry drove out to the Harley-Davidson plant thirty minutes before Steve's shift. Harry told Dennis, "I'm here to determine whether or not Steve is doing his job. I'll be back tomorrow to follow up. Can you let me into the guard's office?"

Dennis admitted Harry to the office and left for the day. Harry took out a small video camera from his purse and turned it on. He then hid the camera in the bookshelf next to Steve's chair and left the building.

Discussion Questions

1. (Work as a team). Discuss the issues around Harry's decision to hide the camera. Using the attached theories of ethics, decide whether or not Harry's actions are ethical.
2. (Work individually). Imagine you are Harry's supervisor. Write a memo to Harry, evaluating her handling of the situation at Harley-Davidson.

Problem Writing Worksheet

This worksheet is offered to help you think about how you will teach a problem you are in the process of writing.

Problem Title:

Author:

**Department/
Discipline:**

Target student population: *(Majors or nonmajors? Beginning or advanced? Large- or small- enrollment? Subject? Other?)*

Length of time/Staging *(How many class periods [of what duration each] will it take? Will it unfold in progressive disclosure format, or be distributed all at once?)*

Niche in course *(When in the semester? What comes before it? What comes after? Will it be a single event, or will other problems be used?)*

Brief Abstract *(of content of the problem; learning objectives for students)*

Format of Delivery *(What will the instructor do - mini-lectures during or after the problem? whole class discussions? How will the instructor help groups to make forward progress and stay on task? How will the instructor/students end the problem? Please provide a brief description of general strategies, then expand on this description for each stage of the problem in the Teaching Notes section below.)*

***Developed by Deborah Allen for Winter ITUE, 2001**

Instructor Resources (*What resources did you consult to write the problem? What content-related resources would another instructor find helpful if he/she wanted to use your problem?*)

Student Resources (*What resources will students use in working through the problem? Which of these, if any, will you provide for them?*)

Stage-by-Stage Teaching Notes (*What are the learning objectives for students? Why did you ask the particular end-of-stage questions that you did - what did you intend them to accomplish? How will the instructor introduce the problem? For each stage of the problem, how will it unfold, including the roles of instructor [lectures? discussions? feedback?] and students? What conceptual pitfalls might the students encounter and how will they get past them? How will the instructor help groups to make forward progress and stay on task? How will the instructor/students end the problem? How will the instructor be assured that all group members have contributed responsibly?*)

Notes (Cont.)

Products (*Will the students have to hand in a product at the end of the problem? Will it be individual or group? Will it be graded? Towards what percentage of the overall grade in the course will it contribute? Which of the problem objectives will it assess?*)

Assessment (*How will you know if students have met the content and process objectives for the problem? Will these assessment strategies be individual or group? Will it be turned in for a grade? Towards what percentage of the overall grade in the course will it contribute? NB: Please fill out this section for any assignments, quizzes, exam questions, etc. that are not described in the "Products" section above, providing examples of specific questions, instructions, etc.*)

Orientation to the PBL Clearinghouse: An Electronic Peer-Reviewed Publication



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Characteristics of Good PBL Problems

Relate to real-world, motivate students
Require decision-making or judgements
Multi-page, multi-stage
Designed for group-solving
Initial questions open-ended, encourages discussion
Incorporates course content objectives
Challenges to higher-order thinking



But...where are the problems?

Typical end-of-chapter problems can be solved by rote memorization, pattern-match, and plug-and-chug techniques

Good problems should require students to make assumptions and estimates, develop models, and work through the model.

A source of problems outside the commercial texts needs to be developed.



PBL Clearinghouse

An online database of PBL articles and problems.
All material is peer-reviewed by PBL practitioners for content and pedagogy.
All problems are supported by learning objectives and resources, teaching and assessment notes.
Holdings are searchable by author, discipline, keywords, or full text.
Fully electronic submission, review, and publication cycle.
Controlled access by free user subscription, students excluded.



A Brief Tour of the Clearinghouse

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Applying to be a user
Searching and Browsing the holdings
Examining problem detail and supporting materials for a sample problem
Managing Clearinghouse activities
Submitting a problem for review

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Comparison of Teacher-Centered and Learner-Centered Paradigms

From Figure 1-2 in Huba and Freed, *Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning*, 2000



What I know best I have taught...

...the individuals learning the most in the typical classrooms are the teachers there. They have reserved for themselves the very conditions that promote learning:

actively **seeking** new information, **integrating** it with what is known, **organizing** it in a meaningful way, and **explaining** it to others.

Page 35, Huba and Freed, *Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning*, 2000



Comparison of Paradigms

Teacher-Centered

Knowledge is transmitted from professor to student. Students passively receive information.

Learner-Centered

Students construct knowledge through gathering and synthesizing information and integrating it with the general skills of inquiry, communication, critical thinking, and problem solving.



Comparison of Paradigms

Teacher-Centered

Emphasis is on acquisition of knowledge outside the context in which it will be used.

Learner-Centered

Emphasis is on using and communicating knowledge effectively to address enduring and emerging issues and problems in real-life contexts.



Comparison of Paradigms

Teacher-Centered

Instructor's role is to be primary information giver and primary evaluator.

Learner-Centered

Instructor's role is to coach and facilitate. Instructor and students evaluate learning together.



Comparison of Paradigms

Teacher-Centered

Assessment is used to monitor learning. Teaching and assessing are separate.

Learner-Centered

Assessment is used to promote and diagnose learning. Teaching and assessing are intertwined.



Comparison of Paradigms

Teacher-Centered

Focus is on a single discipline.
Emphasis is on right answers.

Learner-Centered

Approach is compatible with interdisciplinary investigation.
Emphasis is on generating better questions and learning from errors.



Comparison of Paradigms

Teacher-Centered

Culture is competitive and individualistic.
Only students are viewed as learners.

Learner-Centered

Culture is cooperative, collaborative, and supportive.
Teachers and students learn together.



Outcomes?

Moving away from:

Are students getting the right answer?



Outcomes?

Moving to:

Can students demonstrate the qualities that we value in educated persons, the qualities we expect of graduates?

Can students gather and evaluate new information, think critically, reason effectively, and solve problems?



Outcomes?

Moving to:

Can students communicate clearly, drawing upon evidence to provide a basis for argumentation?

Do students' decisions and judgments reflect understanding of universal truths/concepts in the humanities, arts, *etc.*



Outcomes?

Moving to:

Can students work respectfully and productively with others?

Do students have self-regulating qualities like persistence and time management that will help them reach long-term goals?

Introduction to Assessment in PBL

Courtesy of Sue Groh
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Defining Assessment

“An assessment is an activity, assigned by the professor, that yields comprehensive information for **analyzing, discussing, and judging** a learner’s performance of valued abilities and skills.”

- Huba and Freed, *Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning*, 2000

Assessment is more than assigning grades: it implies ongoing interaction and communication between instructor and student.



Assessment Decisions

Faculty Perspective:

“Learning drives everything.”

- Barbara Walvoord

Student Perspective:

“Grading drives everything.”



Key Questions

- What do I want my students to learn? ⇒ Learning objectives
 - Content knowledge
 - Process skills

- How will I know if they have learned it? ⇒ Assessment strategies
 - Summative
 - Formative

- How much do I value that learning? ⇒ Look at what counts towards the grade



Types of Assessment

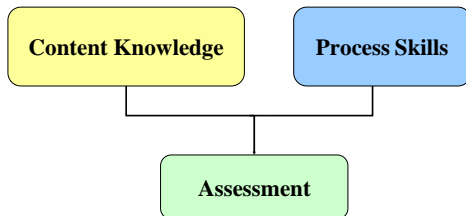
- **Summative assessment**
 - Traditional grading for accountability
 - Usually formal, comprehensive
 - Judgmental

- **Formative assessment**
 - Feedback for improvement/development
 - Usually informal, narrow/specialized
 - Suggestive



Assessment and Learning Objectives

Bringing content and process together





Bloom's Cognitive Levels



- Evaluation** - make a judgment based on criteria
- Synthesis** - produce something *new* from component parts
- Analysis** - break material into parts to see interrelationships
- Application** - apply concept to a *new* situation
- Comprehension** - explain, interpret
- Knowledge** - remember facts, concepts, definitions



Evaluating Learning through Rubrics

Rubric: a set of specific criteria against which a product is to be judged

- Criteria reflect learning objectives for that activity
- Several achievement levels are identified for each criterion
- Benchmark features indicating quality of work at each level are clearly described for each criterion

Rubrics can be used for both formative and summative assessment.



Rubric Design

| | Achievement Levels | | | |
|-------------|--------------------|----------------|----------------|----------------|
| Criteria | Excellent | Good | Needs Work | Not acceptable |
| Objective 1 | Accepted | Minor revision | Major revision | Rejected |
| Objective 2 | Expert | Advanced | Intermediate | Novice |
| Objective 3 | 6-5 | 4-3 | 2-1 | 0 |
| | | | | |



Rubric Construction

| | Achievement Levels | | | |
|--------------------|---|------|------------|----------------|
| Criteria | Excellent | Good | Needs Work | Not acceptable |
| State an objective | Describe characteristic features of each level of achievement | | | |



Advantages of Rubric Use

- Clarifies expectations
- Efficient, specific feedback concerning areas of strength, weakness
- Convenient evaluation of both content and process learning objectives
- Encourages self-assessment: use as guideline
- Minimizes subjectivity in scoring
- Focal point for ongoing feedback for improvement



Other Ideas for Rubric Use

- Have students participate in setting criteria, performance descriptions
 - Use old student work as “data”
- Have students use rubric to rate own work; submit rating with assignment
- Others
