

Problem-Based Learning

An Introduction

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Agenda-Intro to PBL

- Need for a New Approach to teaching
- The Case for PBL
- Teacher vs. Student-Centered (PBL) Approach
- How PBL works
- New Roles (for the teacher, students)
- Wrap-up
- Questions/Discussion

Need for a New Approach to Education

- Productive workers and citizens for the next century...
- Cramming students with today's facts and theories--which may soon be outdated--doesn't prepare people for a changing world
- The story of the origin of PBL in brief
 - Once Upon a Time in Maastricht, NL
 - The Dutch-frugal, life is cheap and the individual is important
 - The tale of medical malpractice...

Need for a New Approach to Education

- Students frequently ask why they need to study a subject or what use the information will be to them
- PBL places learning in the context of the “real world”--deals with problems that are as close to real-life situations as possible

Ultimate Objectives of Education-One View

- Acquire an essential body of knowledge
- Develop the ability to use that knowledge effectively in response to problems
- Develop the ability to extend or improve that knowledge in response to future problems and opportunities--
meta-cognition.

Claims: PBL as Response to Changing Needs

- Ultimate goal of PBL
 - To produce graduates capable of managing academic or professional problems of those who seek their services in a competent manner
- High-level goals, the development of:
 - An Integrated Knowledge Base
 - Problem-solving Skills
 - Effective Self-directed Learning Skills
 - Team Skills

PBL at Its Most Fundamental Level: 3F

- PBL in a Nutshell
 - Encounter the problem *First*
 - A rich problem affords *Free* inquiry by students
 - Students take *Full* responsibility for their own learning
- What is needed to begin:
 - Students are ignorant (but not too much so)
 - Time and resources for individual, self-directed learning
 - Teacher is coach for the social and cognitive processes
 - Teacher as knowledgeable facilitator/tutor
- And then it makes:
 - Different groups define different aspects of problems
 - Groups reconvene, and review problem management

The Case for PBL

- Research on *expertise*--process of progressive problem-solving in which people continuously rethink and redefine their tasks.
- Developing expertise in students involves a process of continually *making knowledge public* in different ways at different moments--to yourself (indiv. research), your group, the professor and the class--at different moments). PBL makes thinking explicit and focuses on sustained inquiry--driven by the student-as it is in the real world by the practitioner.

The Case for PBL

- Cognitive research on comprehension--learning in context and in dialogue with others improves retention and application of knowledge
- Motivational--students focus on problems, issues and questions they create. Students are *engaged* by their own self-directed research
- *Constructive vs. Receptive* model of education

A Prototypical PBL Curriculum

- Knowledge is organized around real problems taken from professional practice—raises the question of suitability across fields of study but there is evidence an entire liberal arts university (UM, NL) can adapt and succeed.

Example of a PBL Problem

The firm, US Steel, has tried to change its approach to its evolving marketplace by moving away from large, flexible, high-volume manufacturing facilities. These facilities produce steel at the lowest costs to customers, but provide customers only with “raw” materials (e.g., cold-rolled steel rod) rather than more finished products (e.g., pre-fab. beams or walls). US Steel is moving to the “mini-mill” model of some notable competitors in order to deliver a limited range of products, but more cost-efficiently and faster than larger mills.

Mini-mills offer lower economies of scale than large plants, which sell more generic materials. Some managers at US Steel wonder about the soundness of trying to be a leading differentiator (mini-mills) and a low-cost producer at the same time.

Teacher-Centered vs. PBL

Conventional Approach

- Textbook centered; rote memorization
- Weekly assignments predetermined by instructor (linear)
- Individual-oriented; little opportunity for collaboration

PBL Approach

- Students decide how they will gather information to solve problems
- Non-linear—students work with time between classes for student-driven inquiry.
- Promotes collaborative learning and team skills

Teacher-centered vs. PBL

Conventional Approach

- Learning is a passive activity
- Instructor-centered
- Spoon-feeding of information in an abstract context (& spitting it back to the teacher)
- Disciplinary isolation

PBL Approach

- Active engagement in learning
- Student-centered
- Problem-centered on authentic tasks--active *discovery** of information in a real-life context
- Interdisciplinary approach--seek to ID & understand the problem(s)--go where the process takes you.

*Discovery by students greatly aids building an integrated knowledge base (where actions are connected to problems)

How PBL Works

- Transforming topics into problems--what problem do we really want students to investigate?
- Does the problem provide:
 - an authentic, real world task?
 - multiple goals?
 - response to student interests?
 - motivation for students to take action?

How PBL Works

- Introduce broad task and open-ended questions that hooks students
- Co-develop with students a plan of inquiry or work to investigate problems of interest
- Conduct the inquiry and analysis

How PBL Works

- Prepare and present findings to one or more authentic audiences
- Engage in authentic assessment activities (Structured Critical Reflection)

PBL: New Role for Instructors

- Instructors move from center stage to the side (students and the subject matter take center stage)
- Instructors act as tutors, guides and facilitators of learning, helping students to formulate, research, plan and solve real problems--the approachable knowledgeable mentor instead of the somewhat-distant 'supreme controller.'

PBL: New Role for Instructors

- Design the problem situation.
- Set the direction for what content knowledge, skills, abilities and attitudes are required for solving problems.
- Guide students through the process of answering PBL questions, but provide no answers--some “hints” as to direction.

PBL: New Role for STUDENTS

- Students
 - are responsible, manage their own learning.
 - undergo a *constructive* experience.
 - face and plan for real-world challenges.
 - execute using real-world tools.
 - cope with real-world roadblocks (and overcome them).
 - bring in and synthesize prior class learning.
 - create a *truly dynamic, very powerful* learning environment, in which they may take pride in their individual and group-based contributions.

Meta-cognition & Knowledge Use

- Meta-cognition or “mission control”
 - Is an essential element of skilled learning
 - Goal-setting--What are we going to do?)
 - Strategy selection--How are we (and I) going to do it?)
 - Goal evaluation--Did it work?)
- Teaching strategies
 - Focus on understanding, not memorization

How Does the Learning *Environment* Affect Students' Learning?

- Achieving more than minimal learning outcomes?
 - Surface approach = syllabus bound, assessment conscious, reliance on rote learning
- Factors resulting in surface approach:
 - Inadequate prior knowledge, time constraints, over-demanding syllabus, frequent assessment for credit, lack of feedback, assessment focuses on recall
- Factors that encourage a deep approach:
 - Active and long-term engagement with learning tasks, clearly stated expectations, teachers' commitment to the material, opportunities for students to exercise

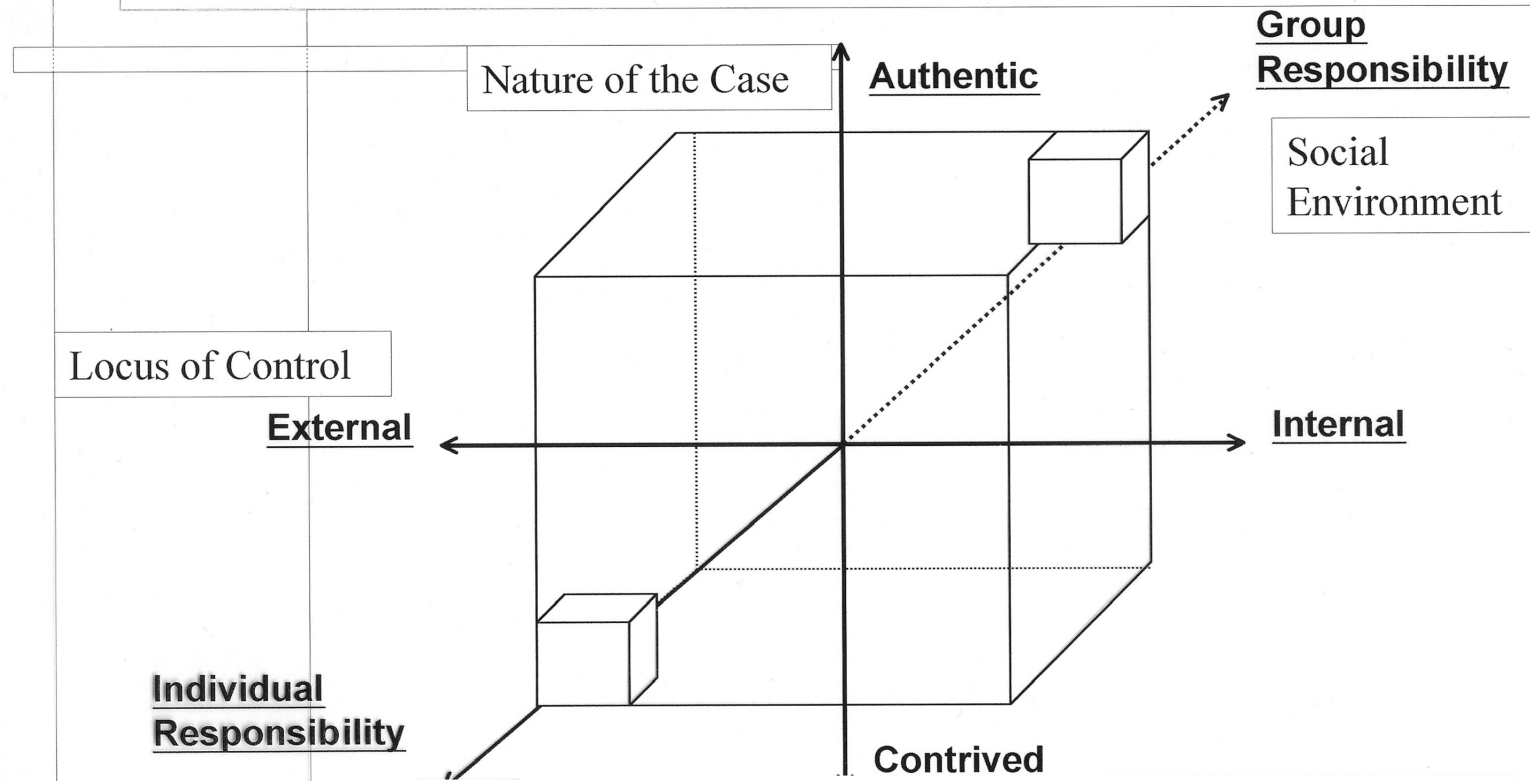
Evidence: Problem-Solving

- Problem-solving Skills
 - General problem-solving skills: no difference
 - PBL students and students from integrated curriculum made more accurate diagnoses than students trained in conventional curriculum
 - *“Integration between basic...sciences + emphasis on...problems may be the critical factors that determine performance and not self- or teacher-directed curriculum”*

Locus of Control

- Students identify about 70% of learning issues incorporated in the problem
 - **Q:** Are students actively engaged in solving problems and developing a sense of ownership?
 - Engagement leads to truly student-driven experiences, but instructors intervene when needed to guide discussion, and critically reflect after audience-students.

3 Factors Affecting PBL Outcomes



Wrap-Up–PBL and Meta-cognition

- Meta-cognition Adds HUGE Value
 - an essential element of skilled learning–Drives student towards:
 - Goal setting (What am I going to do?–Prob. ID)
 - Strategy selection (How am I doing it?–incl. Collab. Strat.)
 - Goal evaluation (Did it work?–Refinement)
- Take-away messages--PBL
 - Focus on understanding, not memorization
 - Constructive vs. Receptive learning mode

Finally: Is PBL Worth the Trouble?

- *“Once anyone is involved as a PBL tutor working with students and has the opportunity of seeing what students can do when given the permission to think and learn on their own, he or she usually becomes a convert.”*
- *“Even if knowledge acquisition and skills are not improved by PBL, enhancing the work environment for students and faculty is a worthwhile goal in and of itself.”*

Reflections

- Students learn only 10% of what they read, but 80% of what they personally experience and 90% of what they teach others.
- Using groups of two or three students to focus on key concepts and report back to the class on their findings reduces inhibitions against class participation. Expanding the group size over time will lead to richer class-wide discussions and other benefits.
- Role-playing fosters richer student understanding of the multiple perspectives inherent in most learning issues.
- Field work and other student-centered learning activities foster personal interest, motivation, and commitment...
- Student presentations not only increase retention and higher level learning, but self-efficacy that extends well past the classroom.
- The instructor has an opportunity to evaluate students in a richer environment, assess genuine learning, and identify areas requiring additional attention more effectively.
- Make the teaching and learning enterprise a lot more fun for everybody!

Lyons (date unknown). The adjunct professor's guide to success: Surviving and thriving in the college classroom. Ch.9.

The Short and Mysterious History of Problem Finding Research

- Merton, 1945
- Wertheimer, 1945
- Mackworth, 1965
- Getzels
- Czikszentmihalyi
- Merton, 1973
 - Nobel laureates “uniformly express the strong conviction that what matters most in their work is a developing sense of taste, of judgment, in seizing upon problems that are of fundamental importance.”

Problem Choice

- The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old questions from a new angle, requires creative imagination and marks a real advance in science.

Wertheimer, 1938

- A problem well put is half solved.

Dewey

Final Reflection

- Human beings are primarily concerned with solving their problems; They perceive reality, they learn from their environment, and they choose and act accordingly to their problem situation. There is no perception per se, but always perception in relationship to a problem. And there is no learning per se either, but always learning about ways (to) solve problems.

Mantzavinos, 2001, p. 8

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Implementation of PBL–Issues

- *“Inappropriately used, PBL will not lead to the potential robust learning...the critical implementation issues...include incomplete or inappropriate use of the process, faculty capabilities and attitudes...”*
- *We were not effectively helping students to make their learning explicit. We were assuming that the students would, as a natural part of the learning process, reflect on their experience and extract abstract knowledge.”*