Problem Based Learning:
Part 3: What Are My Students Learning?

Marian Maxfield, PhD
PBL Design Process

Choose a Relevant Problem of Worth
Develop the PBL Learning Adventure
Build the Teaching and Learning Template
Coach Critical Teaching and Learning Events
Embed Periodic Assessments and Appropriate Instruction

Problem Design

Problem Implementation

Reprinted from Torp & Sage (1998), p. 17. © 1995 Illinois Mathematics and Science Academy, Center for Problem-Based Learning, Aurora, IL.
Overview of the teaching and learning process

1. Introduction
2. Provide Problem
3. Group Assignment
4. Identify, Define, Gather (Researching)
5. Solution
6. “Best-fit” Solution
7. Present / Assessment
8. Reflect
What is Learning?

• How do you define Learning?
  – A cognitive process of acquiring and applying skill or knowledge

• How do you assess your student learning?
Evaluation of Assessment and Assessment Types

• Learning and Teaching is about the *Process* and *Product*.

• 3 types of assessment within PBL
  – Formative
  – Summative
  – Authentic
Formative vs. Summative

• Formative Assessment: Assessment for Learning
  • Conducted during learning process
  • keeps unit on track
  • Non-linear

• Summative Assessment: Assessment of Learning
  • Conducted at conclusion of learning
  • Ensure that learning and application has occurred
  • Assess the learning product
Formal vs. Informal

Formal
- Planned
- Designed
- Systematic
- Pre-determined content
- Examples
  - Tests
  - Question Guides
  - Rubrics
  - Checklists

Informal
- Non planned
- Non-linear
- Pre-determined or undetermined
- Examples
  - Coaching
  - Observing
    - Communications
    - Interactions
    - Learning Products
  - Questioning
Group vs. Individual

- Assess students in groups and individually
- “Slacker” effect
  - One student does all the work in the group
- Group Evaluation Sheets
  - Are you participating, asking question? Why not?
- Group work should be assessed
  - Teaching cooperation
  - Conflict management
  - Roles
  - Leadership skills
Teacher vs. Student

Teacher – Individual or Group
- Questions
- Informal conversations
- Discussion (f2f, blog, forums, etc.)
- Test (Higher level thinking)
- Rubric(s)

Student – Self or peer evaluation
- Check list
- Rubric(s)
  - Problem solving
  - Research process
  - Group work
  - Final Product
- Thinking Logs
- Group Evaluation
  - Self and group members
<table>
<thead>
<tr>
<th>Activity</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
</tr>
</thead>
<tbody>
<tr>
<td>I contributed ideas/facts.</td>
<td></td>
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<tr>
<td>I came up with some learning issues.</td>
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<tr>
<td>I used a variety of resources when doing my research.</td>
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<tr>
<td>I helped think through the problem.</td>
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<tr>
<td>I contributed new information.</td>
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<tr>
<td>I helped my group in doing its work.</td>
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</table>
Knowledge vs. Skills

• Content knowledge
  – Based on standards and objectives
  – Interdisciplinary

• Skills
  – Problem solving, higher-level thinking, reasoning, questioning, self-efficacy, self-directed
  – Incorporated in standards and objectives
  – Checklist
  – Developed over time period
Assessing skills vs. knowledge

• Rubric
  – Provides guidelines
  – Expectations are explicit (focus)
  – Aligned with standards
  – Easy to use
  – Informative and formative feedback for students
  – Organization

• Test (questions based on reasoning and problem solving.)
Current vs. Future

• Can students apply knowledge?
  • Demonstrated throughout product and presentation

• Do students retain knowledge?
  • Assess the skills and knowledge in next lesson
  • Students should be able to build upon last PBL experience
Criterion Referenced vs. Norm Referenced

- Criterion Reference is selected to demonstrate how well the learning outcomes were met
  - Rubric – individualized grades

- Norm Reference is selected to show how well students rank from high to low
  - Bell curve
Traditional vs. PBL Assessments

• Beware: do not use assessments as a way of imposing structure similar to teacher-centered learning (Pedersen, Arslanyimaz, and Willimas, 2009).
Summative

• Paper and pencil criterion referenced test not used alone
• Open-ended creation
• Examples
  – Research paper, projects such as video, website creation, poster, art work, role playing, acting, etc.
• Presentations / Rubrics
# Formative and Summative Review

## Formative
- Cognitive aids
  - Thinking logs
  - Concept maps
  - Graphs
  - Drawings
- Group Evaluations
  - Individual
  - Group
- Check list
- Group Folders
- Individual Folders

## Summative
- Student learning products assessed with
  - rubrics
  - scoring guides
  - self-assessments
  - authentic assessments
- Final Test
- Application
- Retention
- Skills
- Further questions
Authentic Assessment

• Experts Role in Assessing
  – Real world stakeholders / audience
  – Feedback during and at end of PBL
  – Bring in an expert or have students contact experts on the topic during the learning process.
  – Bring in a panel of experts to assess and be part of the final presentations.
  – Debates with experts

• In real world environment – Situated Learning
Assessment Process

- **Co-develop** rubric for final product
  - Content knowledge (based on objectives)
  - Presentation skills
  - Team work / group work
  - Higher-level skills
    - Questioning, listening, conflict management, problem solving, etc.

- **Develop Formative Assessments**
  - This will assist, especially if first time doing PBL

- Content and arrange experts
# Simple Rubric

## PBL Student Product Rubric

<table>
<thead>
<tr>
<th>Element</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem</strong></td>
<td>States a critical problem: within the context of the situation, based on an analysis of alternative problem statements, with logical, analogous or authoritative support.</td>
<td>States a central problem within the context of the situation with support for its importance.</td>
<td>States a central problem.</td>
<td>Identifies a sub-problem.</td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td>Synthesizes data from multiple sources (with references) as the basis for deriving further data. Identifies assumptions of sources and behind the methodologies. Relates knowledge and information to the specific and global context of the problem.</td>
<td>Analyzes data from multiple sources with references related to the context of the problem.</td>
<td>Analyzes data from multiple sources and provides references.</td>
<td>Considers data from one source without references.</td>
</tr>
<tr>
<td><strong>Solution</strong></td>
<td>Analyses multiple options with support for the recommendation, clear identification of assumptions in the analysis and within the problem context.</td>
<td>Presents multiple options with reasons from the research (multiple sources) for choosing one.</td>
<td>Presents a solution with knowledgeable support from the research and attention to how it fits the context.</td>
<td>Presents a solution with some support from the research.</td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>Shows insight into how their individual knowledge evolved through the group process and how the group achieved the solution and the quality of the group interaction in knowledge building.</td>
<td>Analyzes the pivotal points in the group development of the solution. Reflects on own contribution to the group.</td>
<td>Analyzes how the solution developed through the PBL process.</td>
<td>Reviews the steps taken by the group.</td>
</tr>
</tbody>
</table>
Facilitator and Experts Role in Assessment

• Model for and Support Learners in
  – Effectively articulating and demonstrating what they know
  – How they know it
  – Why knowing is important
  – Whom knowing is important
Debriefing the Problem

• Learners reflect on what was learned
  – In their group
  – Through other group products and presentations
  – Experts on panel
  – Different subjects (standards / objectives)
  – about themselves as learners

• Make connections meaningful learning

• Learning does not have to stop. Learners can continue to ask questions and inquire about what they would like to know more. (Enrichment for gifted students)
How to Debrief

• Structure
  – Individually
  – Groups
  – Whole class discussion

• Cognitive Aids
  – The “L” of KWL
  – Thinking logs
  – Higher-level discussion questions (paper or discussions)
  – Electronic portfolios

• Use and order of structures and aids can vary.
Facilitator Assessment and Debrief

• Observation of students
  – Student Engagement
  – Did all student participate?
  – How did student evaluate self?

• Observation of self
  – Did I facilitate higher-level thinking?

• Revisit the problem
  – Did it meet standards?
PBL and Technology

• Transition from
  – teaching about technology to
  – teaching with technology
• Cognitive aids
• Final Products
• Formative Assessments

• Examples
  – Blogs / Vlogs
  – Voice Threads (debrief)
  – Wikis
  – Webpage / website
  – Electronic Portfolios
  – PDF forms or MS Word (Thinking Logs)
  – Charts, Graphs, Drawings
  – Excel for calculations and statistics
  – Kidspiration (preK-5)
Timeline

• Create a timeline for you and your students

• Day 1
  – PBL introduced and explained
  – Scenario and problem are given
  – Problem is discussed
  – Groups Assigned

• Days 2 – 5
  – Researching for students (Individually and Groups)
  – Facilitator questions
PBL and Traditional Lecture

• I have to meet Standards based curriculum
  – Meeting standards and additional real life skills

• It takes too much time!
  – Create a timeline
  – Students learning multiple subjects and skills

• Absenteeism
  – Group Folder for notes for teacher and student to review
  – Technology (online)
  – Resources and concept map created to give to student in advanced, if necessary.

• After 1 time or 1 week, “It didn’t work!”
  – Give it time. This is new for you and your students.
PBL and Learning

• “PBL is not a timeout from school or learning: PBL is authentic learning at school” (Torp and Sage, 2002).
Early PBL Research

• USMLE – Medical students performed better at clinical and application exams and traditional students at recall of basic knowledge (Albanses & Mitchell, 1993; Vernon & Blake, 1993).
Current PBL Research

– Undergrad Physics: PBL vs. Lecture – PBL achieved higher scores on traditional 1-hour test and higher basic physics knowledge (Bowe & Cowan, 2004).

– Urban Minority 6-8 grade over 2 year period with 2% curriculum being PBL. Grade point averages and science grades were higher than traditional lecture (Gordon, Rogers, Comfort, Gavula, & McGee, 2001).