3.3.4 Problem-Based Learning

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Problem-based learning (PBL) is an instructional methodology that challenges students to seek solutions to real-world problems, and in the process, learn, learn to learn, and develop interpersonal and team skills by working in small cooperative groups. The problem-solving process and what is learned throughout this process is often more important educationally than the solution to the problem. Appropriately designed, the problems engage students’ curiosity so that they are motivated to explore the subject beyond simple solutions and to generate tentative hypotheses to explain underlying etiology. As a facilitator helps them recognize that there are many areas in which their knowledge is insufficient to understand the problem or to develop and execute a plan of action, the students identify these areas of knowledge and begin to plan and look for ways to enhance their own learning. Properly facilitated, PBL helps students think critically and analytically and find and use appropriate learning resources. It enhances retention and transferability of concepts, greatly increases students’ enjoyment of and engagement with the learning process, and develops effective self-learning skills.

Why Use Problem-Based Learning?

The hypothesis-driven reasoning strategies that are taught in well-facilitated PBL accelerate the development of expert knowledge and enable forward reasoning to help students face similar problems in the future (Schmidt, 1993). The ultimate determinant of problem-solving competence is the capacity to generate correct hypotheses (Custers, Stuyt, & DeVries Robbe, 2000) based on analyzing, comparing and contrasting the data presented, and transferring the data into abstractions that relate to stored knowledge. To build these structures, well-facilitated PBL helps each learner to

• Think actively about relationships
• Build upon prior knowledge
• Explicitly discuss the steps of his/her reasoning
• Assess new knowledge on the basis of current knowledge and confirm or reject hypotheses on that basis
• Have his/her knowledge validated by peers and teachers

Although PBL students tend to score slightly lower on traditional measures of academic achievement, such as multiple choice questionnaires, they may have enhanced long term retention (Schmidt, Dauphinee, & Patel, 1987). Hmelo (1998) found that, compared with traditional students, well-facilitated PBL students gained more knowledge coherence (more relational linkages), comprehensiveness (deeper elaboration of explanation) and accuracy. Moreover, there is evidence that PBL students are more satisfied with their educational experience, perform better at tasks related to novel problem solving and self-learning, but in the long term, show no greater expertise than students taught in more traditional ways (Vernon & Blake, 1993; Albanese & Mitchell, 1993; Norman & Schmidt, 1992; Colliver, 2000).

The PBL Process (Barrows, 1994)

Facilitating the PBL process is both enjoyable and challenging. The process consists of the following steps, some of which will be repeated iteratively as more is learned.

Steps in Problem-Based Learning

1. Review of objectives
2. Presentation of the “ill-structured” problem or scenario
3. Assigning roles
4. Developing a problem statement from the students’ analysis of what they do and do not know
5. Listing possible actions, recommendations, or solutions
6. Preparing for self-directed learning
7. Listing information, resources, processes, etc. needed to solve the problem
8. Accessing, evaluating, learning, and utilizing information
9. Presenting and supporting the learning and re-addressing the problem
10. Assessment

Step 1—Review of objectives

Course objectives and personal objectives are reviewed to guide and delimit the discussion.

Step 2—Presentation of the “ill-structured” problem or scenario

A problem is presented to the students. The problem can be as simple as a one-sentence description of a situation (“Mark Jones hands you a prescription”). Students should not have enough prior knowledge to solve the problem, but should have enough to recognize that a problem exists.
The problems or scenarios can range from simple, one-sentence situation descriptions to complex modules (e.g., a paper problem that includes all the information that a problem solver could possibly get in a real situation), cases, research problems, etc. Some of the data may be revealed only when the students ask for it.

**Step 3—Assigning roles**
The group process can be facilitated, and cognitive skills may be developed more quickly if some roles are performed in the group on a rotating basis. At the very least, a record keeper is assigned to record the group’s ideas, concepts, issues, etc., on the board, overhead, or computer, using the format described below. It is often useful to assign someone to handle the information resources. Other roles such as task leader, interpersonal leader, quality control expert, etc., may be used as well (3.4.2 Designing Teams and Assigning Roles).

**Step 4—Developing a problem statement from the students’ analysis of what they do and do not know**
Before students can fully develop their problem statement, they need to assess what information they have and what they are lacking. This is best completed if they use a display that everyone can see and that is divided into four sections: facts, information gaps, hypotheses, and learning issues. From this display, students can see exactly what they know, what they believe may be a result of this knowledge, and what they still require in order to fully assess the problem.

**Listing “facts” and “information gaps”**
Under “facts” students list what they know about the situation from the data presented and from prior knowledge. They also identify “information gaps,” which are facts or information not stated explicitly that students would like to have as they consider the case. These gaps may be revealed one by one by the facilitator, all at once in subsequent disclosures, or not at all. In real life, some of the things we would like to know are just not available.

**Developing “hypotheses”**
After the students analyze what they know, they should develop hypotheses. The facilitator assists the group in explicating and recording each hypothesis. When facts and information gaps are disclosed with each part of the case, students may revise or suggest new hypotheses. The inquiry process that leads to the hypotheses is incremental and circular and involves asking questions, observing, probing, examining, and experimenting. They may be based on discrepant events, incongruities, anomalies, or needs. Taken together, the hypotheses must address all ethical issues, time constraints, and resources.

As the problem is explored in more depth, there will often be discrepancies, surprises, confusion, and misunderstanding. Data will often be disorganized and incomplete. Facilitators assist in relevant metacognition and management skills to deal with these inevitable problems. Periodically the facilitator asks someone to review and synthesize the facts, and then asks others to amend and improve the synthesis.

**Listing “learning issues”**
“Learning issues” are aspects of the problem that students do not understand and that represent new areas for learning. A learning issue can be simple and narrowly focused, or it can be broad. Students must find information to fill in the gaps in their knowledge. The facilitator guides students to articulate, explain, and defend their knowledge of relevant disciplines as it relates to the problem at hand. An important but often neglected aspect of PBL is the discussion of fundamental information, principles, and theories that pertain to the problem.

**Step 5—Listing possible actions, recommendations, or solutions**
The students are urged to attempt to solve the problem with what they currently know and to commit to a solution (each student may commit to a different solution). This commitment is important. Students then list actions to be taken (e.g., reading, questioning an expert), and formulate and test tentative hypotheses.

**Step 6—Preparing for self-directed learning**
Students clarify and rank learning issues, and together decide the depth and breadth of learning required to address each issue appropriately. The facilitator supports this process by questioning, probing, calling for organization, encouraging critical reflection, suggesting, and challenging, but only when necessary.

The group then delegates the learning issues. Some are undertaken by all members; some are assigned to individuals who later teach the rest of the group. The facilitator motivates the learning of basic knowledge, concepts, and principles by showing how this will explain, organize, and facilitate retention of the material.

**Step 7—Listing information, resources, processes, etc. needed to solve the problem**
Students and the facilitator discuss what resources will be needed in order to research the learning issues, and where
they can be found. The facilitator should get students to explicitly state where they will be looking for the information and why. When they use primary resources, they develop information access and synthesis skills. When they use secondary sources, they develop information processing and evaluation skills. These options must be balanced. Finally, the students negotiate the time required to effectively address all of the learning issues.

**Step 8—Accessing, evaluating, learning, and utilizing information**

In order to address their learning issues, students access print, human, or electronic information resources: faculty consultants/experts, books, journals, specimens, models, experiences, etc., and study independently. Students need to learn information processing skills to undertake this process effectively and efficiently. When they use information, students must carefully appraise the sources in regards to currency, credibility, accuracy, bias, depth, and complexity. Finally, students should make copies of resources that others will require in their own learning.

**Step 9—Presenting and supporting the learning and readdress-ing the problem**

When they return to the group, students explore the learning issues, integrating their new knowledge into the context of the problem. This is done through verbal presentations, lists, charts, diagrams, or concept maps. Integrating new knowledge is an essential and often-neglected step. The facilitator should also ask students to think of other situations (perhaps earlier problems) in which their new information could be used, and of situations in which a similar-looking problem gave rise to different results. All these problems should be summarized with compare/contrast tables.

Next the students address the problem again, this time as “experts.” They begin again and determine how they would change their thinking and analysis of the problem. This will give them insights about what they should have hypothesized and what they should have asked. Students continue to define new learning issues as they progress through the problem. PBL is an ongoing process, and there will always be learning issues to be explored.

As part of closure, facilitators may require students to communicate their findings and recommendations orally and/or in writing. The product should include the problem statement, questions, data gathered, analysis of data, and support for solutions or recommendations based on the data analysis. Once again, this should be a review and synthesis of the new information learned: new information is integrated into previous knowledge. Previous misconceptions are identified and corrected.

**Step 10—Assessment**

Following completion of each case, the group assesses the performance of each member (including self). Input can be provided by the students, peers, and the facilitator. Reasoning, group behavior, professionalism, knowledge level and self-directed learning ability are assessed. This assessment provides each student with positive reinforcement regarding his or her strengths as well as constructive feedback for rectifying any identified areas for improvement.

**Issues in PBL Implementation (Kaufman, 1985)**

**Cost and Availability of Resources**

**Time**

It will take about 20% more time to teach the same content with PBL. Moreover, PBL is assessment-intensive and both knowledge and skills need to be assessed. It also takes time to develop high-quality cases. However, there should be an almost 100% reduction in time spent on content transmission. Students will find that they spend about 80% of their time in self-learning. Options to consider may include gradual implementation, hiring temporary faculty as writers, using PBL materials from established programs, and raising funds from external sources.

**Information resources**

The library may need to purchase extra copies of heavily used books and paper-based journals. Investment in e-resources is a good idea. Students may want to consider developing a minimal resource set for their team.

**Facilitators**

Many schools find it necessary to hire and train full-time facilitators to manage small group sessions.

**Standardized participants**

Standardized participants are actors who are trained to portray an individual associated with a problem. In medical fields they may portray patients or other healthcare professionals. In business, they may portray colleagues, clients, and administrators.

**Problems**

Problems may be purchased from others.

**Assessors**

Assessors may need to be compensated, especially if there is heavy emphasis on performance assessment.
Student Acceptance

Students come to their first PBL class with skills that are ill-suited to the tasks at hand. Initially, many students may

- Think that the instructor is shirking his or her responsibilities by “making the student do the work”
- Have problems with thinking, self-directed learning, etc.
- Want to “figure out what the teacher wants,” and become very frustrated with the facilitation process
- Want to know what they really have to do to get their grade. They will expect the teacher to prescribe a number of tasks, events, concepts, and a set “number of pages” for written products
- Not know how to handle team issues such as conflict, responsibility, consensus, etc.

Faculty Facilitation Skills

Faculty will need to learn an entirely different and challenging approach to teaching. The main difficulties encountered by most faculty include students resisting instruction; facilitating high-quality problem solving; challenging students to learn material in depth and to integrate it with what they already know; and learning to make their own problem-solving process explicit (3.2.1 Overview of Facilitation).

Concluding Thoughts

Next to apprenticeships and other on-the-job learning experiences, problem-based learning is the most authentic approach to learning available. In addition to facilitating learning and the development of expertise, PBL develops information processing, self-learning, and problem-solving skills (Woods, 1995). After PBL, students usually do as well as traditional students in objective examinations, but they usually retain the knowledge gained much longer and report that the process of learning was much more enjoyable.

References


