Problem Based Learning

Overview

Table of Contents

Overview of Problem Based Learning (PBL)

Introduction

Background

Employees performing complex jobs must understand more than just the content and processes their tasks require. They must be able to apply critical thinking and problem solving skills. When faced with a new challenge, employees must be able to:

- Define and completely understand the problem they face.

- Identify what they already know that will help them solve the problem at hand.

- Identify what they need to know in order to solve the problem.

- Devise a strategy to learn (or at the very least, find) what's needed.

- Implement that strategy.

- Reflect on what was learned and project how it can be applied in the future, as well.
    - This includes what was learned from the problem solving process they've just gone through, as well.

In some cases, employees are expected to work through this entire process in a mere moment (e.g., a customer service rep dealing live with a customer). In other cases, working through this process may take months (e.g., mission specialists planning a manned mission to Mars).

Regardless of the environment, the implication is the same; employees must learn how to learn… they must become self-directed learners. One key emergent learning strategy specifically designed to accomplish this is problem based learning.

Definition

Problem based learning is a constructivist learning strategy where learners work with a facilitator in a team (or set of teams) to solve loosely defined large scale problems designed to lead the learner to meet defined objectives.

Schools of learning   It may be helpful to take a closer look at what's meant by "constructivist learning strategy," as it applies to the definition of problem based learning…

Constructivist learning is one of the three primary views of learning to come out of the last 100 years of educational research:

School of Learning	Description	Premise
Behaviorist	Learning as response strengthening	Learning occurs when the learner strengthens (or weakens) an association between a stimulus and a response.
		Situations are set up to positively reinforce learners when they exhibit desired responses. (May include negative reinforcement strategies for undesired responses, as well.)
Cognitivist	Learning as knowledge acquisition	Learning occurs when the learner places new information in long-term memory.
		Information is "presented" to the learner through textbooks, lectures, online content presentations, etc.
Constructionist	Learning as knowledge construction	Learning occurs when the learner actively constructs a knowledge representation or schema in working memory.
		Learner explores a situation, case, problem, etc. to gain understanding and construct a schema.

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Description of PBL   During the process of solving the problem *(adapted below from information in Kiley, et al, 2000)*, learners work together to:

- Analyze and further define the problem.

- Identify what individual or shared knowledge and experience they already have that will help them solve the problem (i.e., identify what they know).

- Determine what additional information, resources, experience, etc. they need to acquire and/or understand in order to solve the problem (i.e., identify the "gap," or what they need to learn).

- Design a strategy to find, collect, build, learn, etc. the additional knowledge and/or experience (i.e., create a learning plan to fill the gap).

- Implement the learning plan, either as a team or through individual assignments (e.g., explore the identified resources, conduct research, complete training).

- Regroup and share their learnings.

- Validate the definition of the problem.
  - If the new learnings impact the previous understanding of the problem, the team will work to redefine the problem, and may need to adjust the learning plan.

- Apply previous and new knowledge and experience to resolve the problem.

When this process is complete, the facilitator leads a discussion to guide reflections on what was learned; not just the newly acquired knowledge or experience, but also what was learned by going through the process itself. This discussion then changes from *reflection* on the past to *projection* on the future – how will the learners apply what they've learned to new situations and challenges they may face in the future.

Benefits   The major benefits of a problem based learning (PBL) approach are well summed up by Kiley, et al, (2000):

> *"Problem-based learning incorporates many of the practices that are now considered the desiderata of good teaching: it is student-directed, fosters intrinsic motivation, promotes active learning and deep learning, often includes peer teaching,*

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taps into students' existing knowledge, encourages reflection on the teaching/learning process, develops collegial learning skills, is conducive to a research-oriented curriculum, involves timely feedback, and can support student self-assessment and peer-assessment."

So, the PBL approach fosters performance beyond the classroom environment to promote transfer to on the job performance.

Educational versus business environments

Problem based learning has received wide acceptance in the K-12 and university settings, and most readily available PBL resources and examples are from these arenas. Perhaps the biggest difference in PBL between the educational realm and the business environment is the level of guidance provided toward a targeted outcome.

- In education, students are more frequently given very large scale problems (e.g., global warming, world hunger, recycling) that are very loosely framed. This approach encourages the learners to create a framework of understanding, and this is more important than a specific outcome. In this approach, the *journey* is more important than the *destination*.

- In business, employees are more frequently given more specific real-world problems to work with (e.g., decreasing production costs, improving customer satisfaction, decreasing time to market), and the overall experience is "guided" toward a more targeted outcome. This approach still encourages creating the framework of understanding, but the journey and the destination are equally important.

Although finding good PBL examples from the corporate environment is still challenging, the basic constructs that make the strategy successful in the educational environment are in full alignment with adult learning theory, and these do transfer to the business world.

Comparing PBL to other Strategies

Prescriptive vs. experiential

Traditional didactic teaching (i.e., an instructor presents information to learners via lecture presentation, then conducts a question and answer session to ensure understanding) is prescriptive in nature, and is a common strategy from the cognitive school of learning.

Experiential strategies, in contrast, provide opportunities for the student to learn by doing. This is the strategy of choice of the constructivist school, who believe learners "construct" their understanding of the world through experience.

The Illinois Mathematics and Science Academy (1996) compare prescriptive and experiential curriculums across a set of continuums:

Prescriptive Curriculum		Experiential Curriculum
Teacher-centered	←→	Student-centered
Linear & rational	←→	Coherent & relevant
Part to whole organization	←→	Whole to part organization
Teaching as transmitting	←→	Teaching as facilitating
Learning as receiving	←→	Learning as constructing
Structured environment	←→	Flexible environment

(IMSA chart as it appears in Samford website, 2003. Samford University argues that PBL would be more in alignment with the Experiential end of the curriculum, depending on one's interpretation and application of PBL.)

Didactic teaching vs. problem based learning

Two commonly cited problems with the traditional didactic teaching approach are:

- Students retain little of what they learn when taught in a traditional lecture format. (Bok, 1989).

- Students often do not appropriately use the knowledge they have learned. (Schmidt,1983)

The City University of New York (2003) uses these two problems to present a case for shifting to a PBL strategy, as follows:

> *"Since the students forgot much of what is learned or use their knowledge inappropriately, instructors should create conditions that optimize retrieval and appropriate use of the knowledge in future professional practice.*
>
> *"PBL creates the three conditions that information theory links to subsequent retrieval and appropriate use of new information (Schmidt, 1983): activation of prior knowledge, similarity of contexts in which information is learned and later applied, and opportunity to elaborate on that information."*

PBL and other common strategies

The Samford site also contains the following hierarchical chart based on the work of Savin-Badin (2000) to illustrate the differences between PBL and other teaching strategies:

Strategy	Description
Lecture	Information presented and discussed by faculty instructor.
Case-based	Written case histories provided prior to lecture and followed with in-class discussion about content and concepts.
Case method	Written case histories provided prior to class, studied and then discussed in class (typically in small groups).
Modified case method	Incomplete, written information provided and studied prior to class. Within groups, determination made as to additional information needed. Sometimes additional information provided in class.
Problem-focused	Students provided with a simulated problem/scenario.
Problem-based	Incomplete, written information provided and studied prior to class. Focus is on identifying learning issues applicable to resolution of the problem. Content and concepts relevant to learning a key component.

(Savin-Badin chart as it appears in Samford, 2003, based on the work of Harold Barrows in applying PBL in Medical Schools.)

Problem based learning versus problem solving

Instructors and designers may ask, "I always use problems in my training; isn't that problem based learning?" Sorry, Virginia…

In many forms of instruction, including some examples of didactic instruction, new knowledge is presented to the learners, then they're given a problem or set of problems to solve in order to apply or demonstrate understanding of that new knowledge. Even though this is an effective technique, it is *not* problem based learning. As Kiley, et al, (2000) illustrate, "In a PBL curriculum, the problem comes first. It is in discussion of the problem that students work out what information they need to learn." And they later add, "In traditional subject-based teaching students usually encounter a problem when it is used for illustration rather than as a means of applying and developing knowledge."

So, presenting a problem to apply or demonstrate the knowledge, skill, or attitude, does not make your training problem based learning. In problem based learning, the problem is presented first, then the learners develop and implement the learning strategies to acquire the knowledge to solve the problem. As Kiley, et al, (2000) state so eloquently, in PBL, the problem becomes the fulcrum of the learning experience.
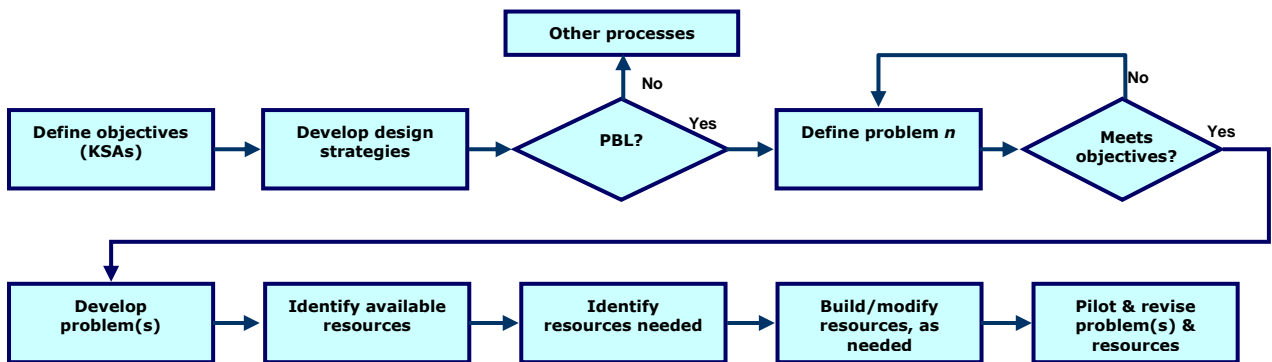
Creating Problem Based Learning

Development Process Overview

Introduction   With a basic understanding of what we're trying to accomplish, let's move on to how to create the problem based learning experience.

Process   The following flow diagram illustrates the basic process for developing problem based learning:

(This process represents a combination of recommended processes and strategies found in the prevalent research.)

Now, let's take a closer look at each of these steps…

Steps in the PBL Development Process

Define objectives (KSAs)

As with developing any learning strategy, the first step is to conduct appropriate analyses, the outcome of which is to define clear and measurable objectives. These objectives will define what the learner will be able to know, do, or feel at the end of the intervention:

Outcome	KSA	Learning Domain
Know	Knowledge	Cognitive Domain
Do	Skill	Psychomotor Domain
Feel	Attitude	Affective Domain

Complete and clear definition of the objectives is critical, as your objectives will be used to develop and evaluate your problem(s), as well as your assessment strategy and tools. Failure to define solid objectives will result in misguided efforts, and will most likely result in extensive rework.

*Note: For more information on objectives, KSAs, and learning domains, refer to the white papers **Objective Types and Approaches** (Thomas, 2001) and **Learning Taxonomies in the Cognitive, Affective, and Psychomotor Domains**. (Thomas, 2001).*

Develop design strategies

Problem based learning should be seen as another option in the designer's toolbox. Not all topics or situations will be an appropriate fit to a PBL approach. Even when PBL is selected as the primary strategy, other instructional design strategies may come into play (e.g., a didactic lecture may be made available as a resource in the team's learning plans).

Exercise:

Write a list of courses you've recently designed, developed, facilitated, or taken. Now, rank each course from 1 (not a good fit for PBL) to 10 (an excellent fit for PBL).

What did you find in common among the low scores? What about the high scores?

PBL?

Problem based learning components should be developed using the steps that follow in the process. Any components of the course that will not be problem based learning elements, including resources to be made available to the learners in a PBL course, will be developed using the most appropriate process for that approach.

Define problem *n*

In this step of the development process, strive to define a problem (or set of problems) that will lead the learners through meeting the interventions' key objectives. According to Glazer (2001), problems should related directly to the learners' environment (i.e., they should have strong fidelity), and should *affect* the learner.

Problem definitions should remain fairly high level (i.e., only define the critical elements of the problem). The selected problem(s) will be fleshed out in the Develop Problem step.

Kiley, et al, (2000) offer the following strategy for defining problems:

> *"If you find (starting with the objectives) difficult, then you can try working the other way around. That is, think of problems in professional practice and work backwards to the concepts and objectives until you have a number of problems that in combination will cover all the objectives you have set."*

Note: This is an excellent opportunity to bring a team of designers and facilitators together for a brainstorming session! To prepare the session, list out all of the objectives on an easel or dry erase board.

Meets objectives?

Once your problem is defined, walk through each of the objectives to determine how the learners will meet the objective by working through the problem.

If you find an objective that is not met through the problem, you can either rework the problem so it does meet the objective, or you can define a replacement or additional problem to meet the objective. Another option is to select alternative instructional strategies to meet certain objectives.

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Note: Multiple problems can be defined, typically building in complexity to provide a "scaffolding" approach to learning.

Develop problem(s)   At this point in the process, you have a clear understanding of the objectives for the intervention, and have a basic problem (or set of problems) defined at a high level. Now, you're ready to fully develop the actual problem(s) that will be presented to the learners.

Characteristics of Good PBL Problems:
The Samford (2003) site lists the following characteristics of good problems:

- Ill-structured, complex problems provide the focal point(s) and stimuli for the course, curriculum, and/or program.

- Learning is student-centered.

- Faculty act as a coach or facilitator.

- Students work in small groups to solve/provide multiple solutions to problems.

- Learner assessment is enhanced by self and peer assessment.

Additional characteristics of good problems appear in Kiley, et al, (2000) based on propositions from Bloom:

- Is engaging and oriented to the real-world.

- Generates multiple hypotheses.

- Requires team effort.

- Is consistent with desired learning outcomes.

- Builds upon previous knowledge/experiences.

- Promotes development of higher order cognitive skills.

Did You Say, "Ill-Structured" Problems?
One of the key leaps designers and facilitators must make is the "ill-structured" problem. This tends to conflict with logic! "Why would you present a poorly structured problem to the learners? Won't that just result in a bunch of questions?" If you're lucky, yes!

"Problem-based learning is a development and instructional approach built around an ill-structured problem which is mess and complex in nature; requires inquiry, information-

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gathering, and reflection; is changing and tentative; and has no simple, fixed, formulaic, 'right' solution." (Finkle & Torp, 1995 in Samford, 2003.)

Kiley, et al, (2000) further explain the rationale for an ill-structured problem:

"Missing information will help (learners) understand what is occurring and help them decide what actions, if any, are required for resolution."

The Samford (2003) site contains the following table to help illustrate the difference between a well-structured and ill-structured problem:

Well-Structured	Ill-Structured
What are the roles of a nurse in critical care?	Euthanasia: Allowing dignity or committing a sin?
What are the start-up costs for a daycare?	As the supervisor, you have noticed there has been a significant amount of absences in the women who work in your department.

Evaluating Your Problem

The Samford (2003) site also contains a chart from the University of Delaware presenting a sample rubric for evaluating PBL problems:

Criteria	Excellent	Good	Needs Improvement	Not Acceptable
Formulation & Scope of Problem	Clear, well thought out; scope well-defined.	Formulation clear, but scope not well-defined.	Formulation somewhat unclear, not well thought out.	Problem not formulated clearly.
Significance	Problem represents current challenge; large potential market.	Problem represents current challenge, but small, vaguely defined market.	Problem is not a current challenge; market small or not clearly defined.	Problem is not a current challenge. No market analysis.

Identify available resources

The resources that support the learning teams in solving the problem can include any and all of the following:

- Books
- Magazine and/or newspaper articles
- Periodical or professional journal articles
- Written materials (notes, briefs, white papers, position papers, etc.)
- Courses (ILT, WBT, certification, webinars, college courses, learning annex courses, etc.)
- Lectures, panel discussions, or meetings with specialists, subject matter experts, public officials, in-house experts, etc.
- Internet (open searches, guided searches, key resource web sites, etc.)

On using multiple resources, Kiley, et al, (2000) point out, "One of the strengths of PBL is that students are exposed to a variety of resources." They also stress that resources should not be compulsory, but simply made available to the learners (this point is covered in the section on facilitating PBL later in this paper).

Identify resources needed

In some cases, you'll decide new resources are needed that aren't available. In this case, the objectives, content, media, etc. of the resource should be clearly defined before development begins.

Build/modify resources, as needed

This step of the process will follow standard development processes and practices.

Pilot & revise problem(s) and resources

As with any complex intervention, you'll want to run through a pilot of the approach and materials, and revise as necessary.

Note: If you can't run a pilot of the approach, you'll at least want to do a peer walkthrough to make sure you catch any major problems with the course.

Questions to ask of pilot facilitators, learners, and/or peer reviewers include:

- Do the problems provide enough breadth and depth to cover the objectives to the appropriate level?
  - If not, how could they be modified or replaced?

- Are there better problems available?

- Were the available resources adequate to solve the problem?
  - If not, what's missing?

- Did the facilitator have everything he/she needed to facilitate the learning?

Once these questions have been answered, you're ready to revise your materials and deliver the course.

Facilitating Problem Based Learning

New Roles

Facilitator

The facilitator's role in the PBL environment is to act as a "cognitive coach." The facilitator provides guidance, not the answers (e.g., suggests resources or exploratory activities and serves as a sounding board for teams' ideas). Glazer (2001)

Kiley, et al, (2000) define the role of the facilitator in PBL as follows:

> *"Throughout this process the tutor acts as a facilitator rather than a teacher. Instead of providing answers, the tutor encourages useful lines of questioning and, where necessary, provides some problem solving structure."*

> *"The tutor in a PBL course is a facilitator. The tutor encourages the students to explore their own knowledge and determine their own learning needs. The tutor generally refrains from providing information, but instead prompts to generate discussion and learning amongst the students."*

They then provide the following methods for accomplishing this:

- Clarifying discussion (e.g., "what are the two different perspectives we are talking about here?")

- Exhausting avenues of investigation (e.g., "are there other possibilities?")

- Putting a problem in context (e.g., "this issue reminds me of another point we raised")

- Prioritizing issues (e.g., "could we put these points in order of relevance to the problem?"

- Intervening in negative group dynamics (e.g., "I don't think we're progressing here. Could we stop and examine what's happening in the group?")

When PBL is well facilitated, the role played by the facilitator eventually shifts to the learners, and they become each others' guides, coaches, and sounding boards. They truly become self-directed learners, which is the ultimate goal of the PBL approach.

The Samford (2003) site presents the role shift from traditional instructor to PBL facilitator as, "instead of being the 'sage on the stage,' the faculty member is now to be the 'guide on the side.'" The facilitator will form a "cognitive apprenticeship" with the learners. Instead of dictating how to solve a problem, the facilitator asks such questions as:

- How do you know that?

- What assumptions are you making?

- What else will you need to know?

Learner

Glazer (2001) describes the learner's role in PBL as follows:

> *"Clearly, PBL is a learner-centric model. Students are responsible for articulating the problem, defining their roles in solving the problem, and offering a solution. They are expected to learn not only information directly related to the problem (e.g., the number of high school students who park at school), but also the method of best presenting their solution (e.g., a written proposal submitted to the principal, or a petition circulated among students). Students learn the skills necessary to solve the problem, and they learn about the rules and constraints governing that solution within the particular learning environment."*

The same underlying message is echoed on the Samford site:

> *"Students also must take responsibility for their own learning. PBL encourages students to identify their learning needs and determine the resources they will need to use to accomplish their learning. With the independent learning comes considerable collaboration with other students and faculty. Collaborative work among students facilitates their comprehension of the problem and the application to future situations. Collaboration is an essential skill for students to gain as they will most likely be working as members of teams in their respective workplaces."*

Impact of this role shift

This is clearly different from the model most learners (and even some instructors) will be familiar with. Kiley, et al, (2000) present the following warning:

> *"This facilitative role is likely to clash with the students' expectations of effective teaching. They will anticipate a directive approach that provides the necessary information or channels them elsewhere (usually a textbook). A common complaint by students encountering PBL for the first times is that their tutor isn't doing anything."*

The Samford site (2003) offers similar admonitions:

> *"PBL contrasts considerably with the traditional teaching most students have encountered. Students have difficulty with the concept and use of self-directed learning (Schmidt, Henny & de Vries, 1992). Be aware that students may react to the idea of PBL with shock, denial, anger, resistance, acceptance, and finally, confidence."*

To handle these issues, the Samford site (2003) recommends orienting learners to the PBL approach by introducing the concept and rationale for using PBL, then having learners work on a sample problem followed by a debriefing session.
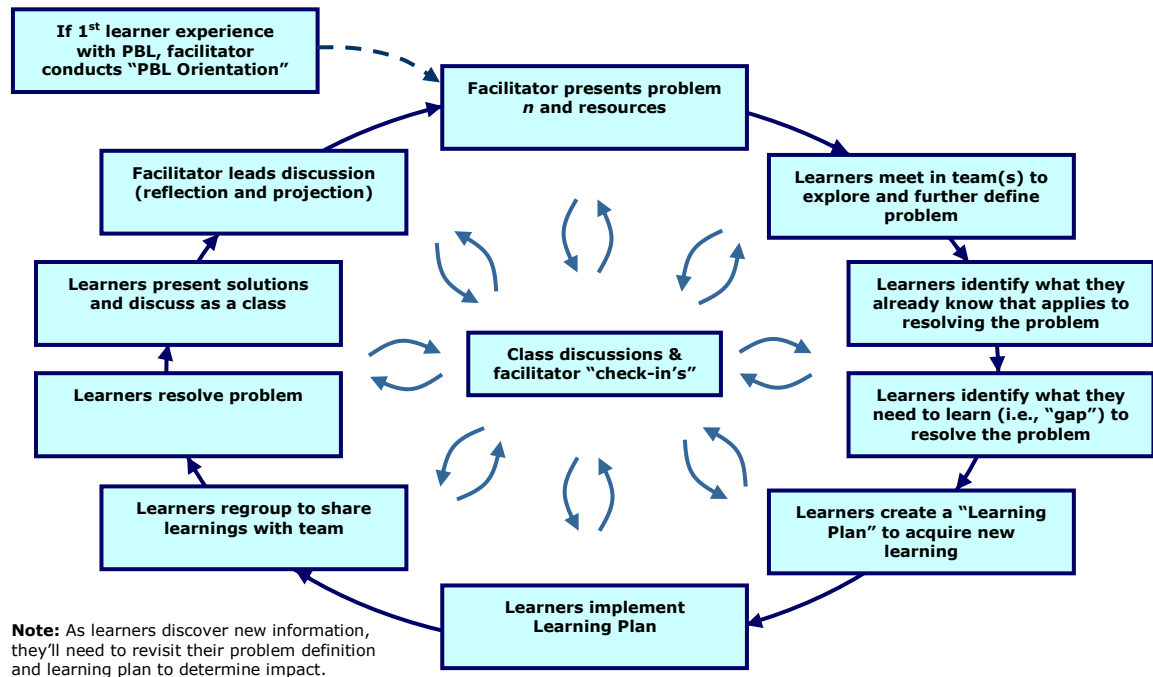
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Facilitation Process Overview

Introduction   Now that you understand how to design the experience, let's take a look at how to facilitate it…

Process   The following flow diagram illustrates the process for facilitating problem based learning:

If 1st learner experience with PBL, facilitator conducts "PBL Orientation"

Facilitator presents problem *n* and resources

Learners meet in team(s) to explore and further define problem

Facilitator leads discussion (reflection and projection)

Learners identify what they already know that applies to resolving the problem

Learners present solutions and discuss as a class

Class discussions & facilitator "check-in's"

Learners identify what they need to learn (i.e., "gap") to resolve the problem

Learners resolve problem

Learners create a "Learning Plan" to acquire new learning

Learners regroup to share learnings with team

Learners implement Learning Plan

Note: As learners discover new information, they'll need to revisit their problem definition and learning plan to determine impact.

Steps in the PBL Facilitation Process

Orientation

Providing an orientation to PBL is a recommended strategy to overcome some of the frustrations that often are associated with a new environment. The following basic process can be used or modified as needed to introduce learners to the PBL environment:

- Introduce the concept and rationale for using a PBL approach.

- "Set the stage" for PBL.
  - Clarify roles and responsibilities (leader, encourager, skeptic, presenter, & scribe).
    - Note: Learners should end up sharing or rotating through these roles.
  - Establish teams of 4 to 6 learners.
  - Establish "rules of trust."

- Work through a simple, small-scale, sample problem, including the reflection and projection.
  - Brainstorm to form hypotheses.
  - Discuss what is known and what is unknown.
  - Brainstorm potential resources (get learners to think out of the box!).
  - Brainstorm a Learning Plan.
  - Discuss self-directed study strategies.
  - Discuss need to revisit problem and reassess based on learnings.
  - Clarify presentation of problem and solution expectations and strategies (e.g., definitions, concepts, abstractions, principles, diagrams, lists, concept maps, flow charts).
  - Discuss evaluation strategies (peer versus facilitator-based strategies).
  - Facilitate reflection and projection discussion.

Present problem & resources

Presenting the problem can be as simple as handing out a set of cards to as complex as staging a dramatic presentation. The problem can be presented in written format, audio, video, web-based screens or animations, etc.

Note: This step offers an excellent opportunity to motivate and engage the learners!

In addition to the problem, the facilitator will offer the initial set

of resources available to the teams. Some resource strategies
have already been included earlier in this document, including:

- Books
- Magazine and/or newspaper articles
- Periodical or professional journal articles
- Written materials (notes, briefs, white papers, position
  papers, etc.)
- Courses (ILT, WBT, certification, webinars, college courses,
  learning annex courses, etc.)
- Lectures, panel discussions, or meetings with specialists,
  subject matter experts, public officials, in-house experts, etc.
- Internet (open searches, guided searches, key resource web
  sites, etc.)

Make it clear to the learners that these resources are not an
exhaustive list! They can request additional resources, or even
brainstorm how to create the resources they lack!

Kiley, et al, (2000) make the following recommendation for
providing and managing resources:

> *"Some resources (e.g., discipline databases) can be easily
> accessed by students. Others may be difficult to access or in
> high demand and should be 'controlled' in some way, such as
> a library reserve system.*

> *"None of the resources should be considered compulsory, as
> this takes the learning initiative away from the students. The
> tutors will require tutor briefing notes that detail the problem
> objectives, how an expert would reason through the problem,
> which are the important cues and their significance,
> recommendations about timelines, and a list of resources."*

**Explore & define
problem**

Remember from the design section that the problem in a PBL
environment is ill-structured… it does not, on its own, offer
inherent strategies to solve the problem. The first action for the
PBL teams is to explore the problem and define it more fully;
some of the questions learners should be exploring at this stage
include, but are not limited to, to the following:

- What are the key factors and issues involved in the problem?

- Who is impacted? How?

- What are the potential causes and contributions to the
  problem?

- Are there systems at work behind this problem?
  – Note: This does not mean computer applications, but rather natural systems.

Team brainstorming is a strongly recommended strategy at this stage of the process. Teams should find a way to create a shared understanding of the problem, then come up with a strategy to present this shared understanding to the other teams.

These presentations may use pictures or diagrams, but this is not a requirement. Facilitators should avoid directing what form the presentation should take. The role of the facilitator at this point is to guide the learning teams toward having a "rich" enough problem definition to begin working the problem.

Identify what is known

Adult learners aren't "blank slates" to be written on… this truism from Adult Learning Theory is probably better applied at this phase of the process than in any other learning approach available.

Learners work together to build a collective knowledge of what they know as a complete team that will contribute to solving this problem. Questions the teams should be exploring include:

- What experience do we have that relates directly to this problem?

- What about *indirect* experience? What would transfer? What wouldn't?

- What successes have we had that relate? What failures?

- Again, what transfers? What does not?

Much of this experience and knowledge probably came into play as the learners were exploring the problem, but it's a good idea to prompt learners to take a moment after this step to see if their shared knowledge has an impact on their understanding of the problem.

Identify what needs to be learned

After the learners have defined the problem and identified everything they know about the problem, they're in a position to do their own "gap analysis" to define what knowledge, skills, or attitudes (KSAs) they're missing that will enable them to solve the problem.

Note: In the Business PBL approach (guided), the facilitator will have a challenge here. The facilitator will have an excellent picture of what the learners will need to learn in order to solve the problem, so the challenge is to provide guidance without being overly directive. One strategy to overcome this challenge is to use a series of questions designed to uncover areas missed by the learners. Remember, however, that the end goal is to have learners take on that role for themselves, so even this technique may need to be lessened as time passes.

Create a Learning Plan

Okay, let's get our bearings… The learners have defined the problem, have access to the baseline resources, and have developed a set of what KSAs they're missing in order to solve the problem. Their next step is to devise a strategy to fill that gap using the available resources (or by going beyond the available resources). They need a Learning Plan.

The first step of developing the plan is for the team to turn their gap KSAs into basic objectives. The facilitator doesn't need to present a session on Mager, but might want to make sure the learners are at least writing clear objectives that get to the root of the knowledge, skills, and/or attitudes they'll need to successfully solve the problem.

Note: In a guided PBL experience, the facilitator will work to ensure the learners include the baseline objectives into their learning plans.

Once the team has defined their objectives, they can work with the resources to build a strategy to meet them. This plan may involve group learning or a "divide and conquer" approach. Typically, there will be a combination of approaches to achieve their learning.

Implement Learning Plan

The team goes into motion! Individuals or sub-teams hit the resources to meet their objectives. During implementation, the team may reform to make sure their learning plan is working out – changes are made on the fly, as needed.

The facilitator may provide guidance at this point to keep learners from trying to learn all that is learnable. The learning should be focused on solving the problem. Especially during "deep dives" into the content, the learners should have a very clear target in mind: meet the objective and bring back learning

to the team that will help us solve this problem. Wiley et al. (2000) offer this guidance:

> *"The object for each student is to get information and develop understandings relevant to the problem as defined by the class. Trawling for masses of information will not be helpful; The second point is closely related to the first. The information is gathered with one eye towards the presentation of that information to the class. The information must be both relevant and understandable."*

So, information is not just being "gathered," it's being organized into a form that's presentable to the team… in other words, the learner is performing selection, organization, and sense-making of the content… isn't this pretty close to how most of us define learning?

Share learnings

If one element differentiates PBL from any other strategy, it's this: learning is achieved through the social aspects of the process… the team communication and shared responsibility for learning. All of this culminates in the sharing of learnings phase of the PBL process.

Here's where the team members bring their learnings back to the team and present them to the team. An interesting phenomenon happens during this phase – as the learners acquire more knowledge, their understanding of the problem will most likely transform ("the problem changes as information is found" – Kiley et al. (2000)). The learners may interpret this as, "Oh *(deleted explicative)*! All of our strategies have been geared toward solving the wrong problem!" This is no time to panic! This rarely results in a "throw everything out and start again from scratch" situation; it's more typically a discovery of some additional gaps to fill.

This is the time to work to redefine the problem, re-explore what they know (including their newly acquired knowledge!), and what they need to know (gap) to solve the redefined problem. Armed with this information, the team can create a new or revised Learning Plan. As Wiley et al. (2000) point out:

> *"In this way the cycle continues from the start as the students close in on more refined definitions of the problem and discover more pertinent information for resolving it."*

Note: When building a course schedule, it would be wise to build in a couple of opportunities or "checkpoints" for the teams to come together and explore their problems and validate their understanding and approaches.

Resolve problem

This step actually begins as soon as the problem is defined. As far as an "official" session, this is the point where teams create their presentations about their solution.

Note: This will vary widely depending on the environment and the problem.

Present & discuss solutions

Presentation strategies and ideas should not be predefined by the facilitator. The facilitator may offer a couple of ideas earlier in the process to get learners thinking about their presentation strategies along with their solutions. This idea seeding might include basic presentations (easels, dry erase boards, posters, role plays, skits, etc.).

Note: As with any presentation, learners may be nervous and anxious about presenting to the class. The facilitator's role is work toward a "feeling" that Glazer (2001) associates with success in the PBL classroom:

"Students should feel "ownership" of the problem, and thus feel that their contributed solutions are both original and valued."

Reflect & project

The key to discovery-based learning is the reflection phase, where learners take a moment to reflect on what they've learned and incorporate this learning into their understanding of their world. This same reflection is critical to successful PBL.

While reflection in discovery-based learning may be an individual experience, sometimes even meditative, the reflection in a PBL environment should be facilitated through open discussion with the team. Again, this social aspect is what differentiates PBL from other strategies.

Reflective questions can include:

- What did I learn about the problem?

- What did I learn through solving the problem?

- What worked well? What didn't? What are the implications of both of these for working like this again?

- What did I learn about myself?

- What did I learn about my team?

- What did I learn about sharing responsibility with my team?

- How can I apply any of this to the same problem in the future? A similar problem? A different problem altogether?

The facilitator's goal at this point in the process is to guide learners to the realization that what they've learned can apply to solving not only similar problems, but totally different problems, as well. Guide the learners toward envisioning how they will use all their learnings back on the job.

Also, this phase is about building a culture of self-directed learners who see the value in taking responsibility and ownership of their own learning. Some questions that may help spark this discussion would include:

- How did you feel when the facilitator didn't answer your questions directly, but rather asked you a question instead?

- At what point did you and/or members of your team start taking over the facilitator's role?

- How did that feel at first? How did it feel later? How does that feel now? How will it impact you in your next class?

<u>References & Resources</u>

References & Resources

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