

Unit 3: Selecting a problem for PBL



Introduction

This unit will focus on providing guidance on selecting a problem in your company that is suitable for PBL.

Problems often are perceived negatively (Dahlgren and Oben 2001). However in problem based learning problems are used to encourage enquiry and stimulate thinking. (Kjellgren et al. 1993)

In PBL the problem presented to the learner is known as the trigger as it's objective is to 'trigger' a sequence of learning and thinking. Therefore it is important to present a problem in a manner that stimulates inquiry

Selecting the correct problem for PBL can affect the success of learning. (Kjellgren et al. 1993; Boud and Feletti 1991; Gijsselaers and Schmidt 1990; Van Berkel and Schmidt 2000)

There is much research surrounding the design of effective problems for PBL in higher education. Most of these design principles are concerned with directing the learner towards the relevant content and learning objectives as they are aimed at teaching the principles in a set curriculum.

However in the workplace problems are readily available and the issue is concerned with selecting the correct problem for the learners and how to present that problem. The content that the learner is required to learn is not set by a curriculum. The content the learner acquires to solve the problem is sufficient to satisfy the learning needs of the company.

This unit examines a number of different elements that need to be considered when selecting and presenting the problem to workplace learners for PBL. These are

- Lesson 1: Learner profile
- Lesson 2: Problem profile
- Lesson 3: Problem presentation
- Lesson 4: Categorise the problem
- Lesson 5: Sample PBL problem and Assignment

There are detailed videos, text and slides to support this material at www.archimedes2014.eu

In each lesson you may be provided with additional reference material for further reading which must be studied.

There will also be tasks to complete in some lessons to provide you with opportunities to apply what you have learned in the workplace.

At the each of the unit there will be an assignment for you to complete which is related to what you have learned.

Lesson 1: The learner profile

When selecting a problem for PBL it is important that you examine the profile of the learner in the context of their ability to solve the problem.

In your organisation you probably have many problems you face. All problems could be suitable for PBL however it is important that you select the correct problem for the correct group of learners. To do this you must identify the learners

- 1) Level of self directedness
- 2) Prior/existing knowledge
- 3) Level of interest and motivation for solving the problem

1) Self directedness

Supplementary Video Resource

<https://youtu.be/3L9qU7Y-ooA>

In Unit 2 lesson 4 (link) we looked at the importance of developing self directed learners to facilitate a learning culture. We examined the different stages of self directed learners and tasks that can be allocated to learners at each stage.

When selecting a problem for PBL it is important to consider the level of self directedness of the learner and that the problem encourages self directed learning.

To encourage self directed learning in PBL it is important that the problem is not too structured. The problem should be presented in a way that requires the learner to explore answers to questions.

If a learner has a low level of self directedness selecting a simpler problem which has more clarity may be appropriate for the initial PBL process. However there still should be some level of exploration and questioning involved.

Example

For the problem: Machine X has a lot of downtime compared to other similar machines.
How do we make the production line more efficient

You might include questions such as: Why do you think this is? How old is the machine?
Is it a different model to other machines? How often is it maintained? What are the major
Issues reported about this machine?

Once the learner has successfully executed the above example, a more complex problem may be chosen for the next time.

If you have a mixed group of learners with various levels support may come from peers and so a more ambiguous problem may be selected.

2)Prior/existing knowledge

Do the learners have a knowledge of the problem already? This is important and is it will encourage the learners to bring what they already know to the situation and allow them to build on this. It will also instil some confidence in the learners to encourage self directedness.

Soppe, Schmidt, and Bruysten (2005) found that the more familiar a student was with the problem it would activate their prior knowledge, stimulating interest and resulting in more time spent on solving the problem.

The more relevant the problem is to the learner the more likely the PBL process will be successful.

3)Level of interest in the problem/ Motivation for solving the problem

Often the learner may need to spend some of their own time trying to address the problem. It is important to select a problem that they are interested in and can benefit them in some way. The problem should motivate the learner intrinsically. It is important to articulate the benefits of solving the problem to the learners and why it is important to the organisation.

In a study conducted by Sockalingham and Schmidt (year – check reference) it was found that an interesting problem was perceived as one of the second most important aspects of problem design to the learner. In particular one responded stated that

“I would think that it is highly interactive and interesting when we are given problem statements that concern our everyday way of life.” (reference as above)

Perhaps solving the problem will make their life easier or it will improve business for the company thus improving job security and opportunities. Perhaps it is a problem they always accepted and had not thought about answering.

Example

In a persons role they might experience issues with a particular machine that is preventing them from reaching their weekly targets. They might accept that this is a problem that they have to deal with. But when offered the opportunity and the responsibility of examining the problem and identifying and implementing a solution they may jump at the chance as it will make their role easier.

Lesson 2: Problem profile

When selecting a problem for PBL it is also important to understand the characteristics of the problem in relation to the learner profile

- 1) Problem difficulty
- 2) Problem context
- 3) Promote team work

1) Problem difficulty

Problem difficulty must be considered in the context of the learners undertaking the PBL process. Problem difficulty is related to complexity and structuredness (Jonassen and Hung, 2008).

Complexity refers to the number of elements in the problem that a student may be challenged with.

Structuredness refers to the number of solutions to the problem. A well structured problem has one solution whereas an ill structured problem is less defined and so has a number of solutions to a problem

Example

Problem: How can we develop new business opportunities?

New business opportunities could have a number of different elements such customer needs, market constraints, customer behaviour, distribution channels... the list goes on.

To address this there may be a number of different solutions develop new products, promote the product more effectively, export products, improve accessibility by developing an e commerce site.. the list goes on

In a more defined version of the above problem (for less self directed learners)

How can we export our product to Asian countries?

The elements are mainly concerned with the market itself and the customers in a specific market rather than in several areas. There are fewer solutions, you are exporting an existing product to a new market however you may need to consider minor product changes and issues regarding export law and customs

In general the problem must be challenging and difficult however the level of difficulty will depend on the learner profile and if they have undergone the PBL process previously.

2) Problem context

As mentioned previously a problem can be take from a number of different contexts with a number of different solutions. In PBL in higher education the context is the objectives of the curriculum and developing a set of discipline specific skills.

In the workplace however there is less focus on the context of the problem from a discipline perspective and more about the problem from the context of the organisation and what approach best suits the needs of the organisation.

Hung suggests that "When designing problems for a curriculum that is not profession-specific, the instructional designers can identify several possible applicable contexts and then select the one that would be most appealing to the learners"

However in a workplace context is not dependant on discipline it is concerned with exploring different contexts of the problem and selecting the most appropriate solution for the organisation.

If the problem needs to be explored within a particular context e.g. Financial, engineering or marketing context it is important to specify this.

If not it is important that the facilitator identifies the ideal scenario for the problem after it has been solved rather than emphasising what context it should be explored in.

Example

If we go back to our previous example where a particular machine has a lot of down time. The problem might state that the machine is unavailable for 15 out of 40 working hours during a week. The objective might be to get that down to 2 hours per week. The context in which that problem is addressed depends on the best solution to reach that objective.

As mentioned previously there may be a number of different solutions to the problem such as training the operator more efficiently, maintaining the machine in line with the manufacturer's guidelines rather than the company's own in-house guidelines, increasing the maintenance of the machine or replacing a particular part.

To reach the optimum solution it is important to put together a group of learners from different perspectives/contexts to identify the feasibility of each solution. A PBL group of an operator, supervisor, engineer and facilities manager may be required.

It is important however that each member of the team has a context of that problem. For example there is no point in making a marketing manager part of the PBL team for the above example as they do not have any context of the problem or any impact on how to solve this.

3) Promote team work

One of the main characteristics of PBL and an effective learning is collaboration. The problem should be large enough to allow a number of different people to work on a variety of solutions.

As mentioned previously particularly in companies the solutions to problems are often multi-faceted and may involve a number of perspectives to address successfully.

Lesson 3 Presenting a problem for PBL

Hung (2006) developed a 3C3R model for presenting PBL problems to learners in higher education. He suggests focusing on

3 Cs which are:

- Content
- Context

- Connectedness

And 3Rs which are:

- Research
- Reasoning
- Reflecting

We will look at each of these in the context of the workplace.

For further study please go to

Click the text below for Further Reading
3C3R Model

The 3 Cs are concerned with the knowledge and content projected in the presentation of the problem and how it to integrate it.

1) **Content**

In Hung's model the content component focuses on the ability of the PBL process to cover the breadth and depth of content required in the curriculum of discipline/module being studied. Therefore the problem must be presented in a way that directs the learner to study the correct amount of content to the correct level.

However as mentioned previously this is not relevant in work based learning.

Therefore when designing the presentation of a problem in an organisational context it is important to consider what is already known about the problem and what content can be given to the learners to enable them to address this problem.

Is there sufficient information to allow the learner to solve the problem and are enough facts known about the problem ? This will depend on the clarity of the problem.

For example if a problem is concerned with a company attracting new customers what past approaches have they tried, what sectors do their main customers operate in?

Hung also emphasised the importance of specifying the scope of the problem when designing the content of the problem to guide and support learners.

2) **Context**

The importance of context was discussed in the previous lesson.

In Hung's model context emphasises the importance of the authenticity of a problem to a given profession or discipline as it improves the ability to retain and recall the knowledge constructed

If you wish the PBL group to study a problem in a given context or from a particular professional perspective it is important that you state so in the problem design.

3) **Connectedness**

In Hungs model connectedness refers to curricula which are being delivered as a series of problems that the problems must be inter related to prevent the learner from 'compartmentalising their knowledge'. By illustrating the connectedness between problems it allows the learner to integrate the knowledge from different problems. There are different methods of doing this by

- 1) Complexity – increasing the complexity of the problem as the learner progresses through the curriculum. This was suggested in Unit 2 in which the complexity of the problem should increase as the self directedness of the individual improves.
- 2) Overlapping – referring to similar problems that were encountered previously or previous efforts to solve the problems. This can be seen in the previous example where we referred to previous efforts to attract customers.
- 3) Multifaceted approach – test ideas in different contexts. Within a company environment this will be done anyway. It is expected each person in the PBL group will have different hypothesis depending on their role and they will test these during self study.

In the problem presentation it is important to refer to any similar problems that have been encountered or other efforts at solving the problem that were made.

The 3 Rs

The three Rs are concerned with the components which are presented in the problem required to ensure that the learner successfully engages in the PBL process.

1) Research

This involves outlining to the learner what is required from the PBL process by specifying the goals you expect them to attain throughout the process. These goals can be from an organisational and a personal perspective.

In a study conducted by Petrosino (1998) it was found that students which received specific goals for the PBL project illustrated a better understanding of the content they learned as well as using methodologic approaches to research and data collection.

By articulating the goals of the PBL process it reduces the concerns students have with the ambiguity of PBL. (Hung 2006)

Within an organisational context this might involve specifying in particular what you want the learners to examine, what you want to achieve for the organisation and what you want the learners to achieve from a professional perspective at the end of the PBL process

Example

For the problem: How do we export products to Asian markets without a physical presence?

You might set the objectives for the learners to examine

- Customer buying behaviour
- Excise and customs laws of the receiving countries
- Export and trading laws in EU
- Transportation mediums
- Distribution partners

Organisational objectives:

- Increase sales to Asian countries by 10% in the next year
- Attract 20 new Asian customers
- Set up 2 distribution channels to these customers

2) Reasoning

This involves encouraging the learner to apply what they have learned from research. In PBL the learners are required to "analyse information, generate and test hypothesis and put their knowledge to the test"

The problem must be designed in a way that encourages the learner to apply reasoning techniques

For example going back to the problem: How do we export products to Asian markets without a physical presence?

You might expand the objectives to encourage reasoning and application, this will contain verbs such as explore, research, apply, analyse, adopt, integrate.

- Explore the customer behaviour in Asian markets and determine how it might impact on our we offer our product
- Research the excise and customs laws of receiving countries and what feasible measures we need to implement in our organisation to satisfy these requirements

3) Reflecting

Supplementary Video Resource

<https://youtu.be/6dluwVks444>

Reflection is a key part of PBL and an aspect which builds critical thinking. It allows the learner to understand solutions they might have missed or approaches that might have made the learning process more effective.

Usually reflection in PBL is done under the guidance of a facilitator. However Hung states by building this element into the trigger or problem design it can encourage learners to be more independent and 'cultivate habits of the mind to reflect'

When designing a problem for PBL it is important to articulate how you want the learner to reflect. Reflection can take place throughout the PBL process (formative reflection) or at the end (summative reflection).

Through building in reflection it can allow the learner to articulate their mental models throughout the process. Which we spoke about as part of a learning culture. In addition it can help companies to understand the decision making process undertaken which can be applied to other similar problems.

Hung suggests for formative reflection ask the learner to record during each stage of the PBL process:

- (1) if they have acquired the breadth of knowledge that the PBL problem requires.
- (2) If they have studied the topic at the sufficient depth
- (3) What research methods they have used and if they are effective and efficient.
- (4) What reasoning processes they have used and are they logical and effective.
- (5) If they integrated their knowledge conceptually

- (6) If their problem-solving strategies are effective

For summative evaluation Hung recommends that you ask the learner to examine

- (1) Process of how they researched the information related to this problem,
- (2) The logic of how they linked the key points that led to your hypothesis and solutions, any alternative hypotheses and solutions,
- (3) The reason you selected your solution,
- (4) How you would solve this problem differently if given a chance to start over” in the PBL problem)
- (5) follow-up problems or questions.

Lesson 4: Categorising the problem

To support the learner sufficiently throughout the PBL process and to encourage the learner to seek the relevant support it is important to categorise the problem. You must specify which of the following the problem is (Jonessan and Hung 2011)

Problem Type	Example
Troubleshooting – this is mainly aimed at technical problems and highlights faults with a system or an approach and identify a solution	How to fix a machine on a production line. Fixing a bug in an IT software system
Decision making These problems require learners to decide on which solution to pursue out of a number of different alternatives. It is complex and depends on a number of factors	To increase the number of customers should a company export to a different country, increase marketing activities or reduce prices?
Strategic performance This is a complex problem which may require a number of approaches to solve an overall problem.	To improve cash flow a company may need to use forecasting methods to reduce over ordering stock, collaborate with customers to improve forecasting accuracy and negotiate with suppliers regarding credit terms
Design problems – associated with how to design a product, business or a process within a company.	To break into a new market a product may need to be redesigned taking into consideration the customer requirements.

Click the text below for Further Reading
 Jonassen's problem solving for PBL

Lesson 5: Sample PBL problem

Note: this can be done collaboratively with the learners or by the facilitator prior to presenting the problem to the learners

Problem title: Increasing revenue for ABC Ltd

Learner profile: The PBL group is expected to comprise of three employees from finance, marketing and sales. Two learners are at the early stages of selfdirectedness (level 1/2). Therefore the problem must have a low/medium level of difficulty/ambiguity. (self directedness)

All of the employees are familiar with the problem as they are aware of a reduction in sales and the increased competition that the company is currently exposed to in the existing market. (familiarity)

The sales and marketing personnel spend a lot of time chasing leads and sales and only 20% of these are fruitful due to a large amount of competition. These staff are working hard and despite this are finding it difficult to reach their sales targets. The finance personnel are aware of the difficulties the business is in and the impact to the organisation if sales do not increase.

Therefore all parties have a high interest and motivation for solving the problem
(interest/motivation)

Problem characteristics

Difficulty: Due to the level of self directedness of the learners there must be some structure and scope on the problem. It will be narrowed to focus on the expertise relevant to the PBL group and will contain some structure to guide the learners

Context: The problem will be tailored to examine solutions in the context in which the proposed PBL group will operate. This is sales/marketing/finance

Team work: The problem is a large problem which has a number of different elements and perspectives to solve it is therefore favourable to PBL.

Problem description (to be presented to the learner)

Problem Overview (Content)

Over the past 5 years ABC Ltd market share in Europe has decreased by an average of 3% each year. This is having a huge impact on the companies revenue and its ability to operate at a profitable margin which satisfies the shareholders requirements.

Current net profit percentage is 5% compared to 10% five years ago. This has been due to the increase in expenses and a reduction in the number of customers due to price increases

Problem Context

ABC Ltd would like to examine how the company could operate in the Asian market and start exporting products to this market in the next 6 months. The company does not want to set up a physical presence in this market due to the costs associated with it. The company would like to offer their existing products in this market with minimum production changes.

(Connectedness)

Past attempts at increasing revenue have included

- 1) Recruiting an extra sales person
- 2) Development of two new products to address emerging needs of the customers
- 3) Improvement of the credit terms offered to customers

Research required (research and reasoning)

- Examine the customer buying behaviour in Asia and how it might impact on how we will sell the product the those countries
- Research the excise and customs laws of the receiving countries and what measures the company need to adapt to address these
- Research the export and trading laws in EU concerning exporting with Asian countries and identify if our company satisfies these laws and if any amendments need to be made to our practices
- Research the various transportation mediums and select the most appropriate medium
- research distribution partners that will sell our product in the Asian market and select the most appropriate partner for the organisation and our products.

Organisational objectives:

- Increase sales to Asian countries by 10% in the next year
- Attract 20 new Asian customers
- Set up 2 distribution channels to these customers

Reflection

Throughout the process record

- (3) Have you acquired enough information to allow you to understand the problem and understand potential solutions
- (4) Have you analysed the data sufficiently to allow you to develop and implement a feasible solution that meets all the requirements.
- (3) What research methods did you use and were the effective (how did you gather and analyse the data to identify a feasible solution)
- (4) What reasoning processes the have used and are they logical and effective. (how did you apply the data to implement the solution)
- (5) If they integrated their knowledge conceptually (have you integrated all the required knowledge from different contexts and perspectives to reach a solution that satisfies all the needs of the organisation)
- (6) If their problem-solving strategies are effective (what approaches are you using to solve the problem)

At the end of the PBL record

1. How did you connect the data to develop a solution?
2. What was the reason you selected this solution?
3. How you would solve this problem differently if given a chance to start over” in the PBL problem)
4. Do you have any follow-up problems or questions.
5. What other problems would you apply the PBL process to?

Problem category: Strategic

Lesson 6: Assignment

Formulate a problem for PBL for business professionals

Identify a problem for a particular learner profile for PBL, the characteristics that the problem should have and present the problem in a manner compliant with the 3C3R model