

Problem-based and team-based learning strategies in the education of biomedical and natural sciences

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D3.3c Guidelines on the use of various types of Scenario-Based Learning

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1 Introduction

This document provides guidelines for the use of Scenario-Based Learning (SBL) in those learning delivery activities which have been developed and compared in this project, namely Problem-Based Learning (PBL) and Team-Based Learning (TBL). These guidelines are based on findings from delivering SBL within the TELSON project and from prior expertise within the project consortium.

Scenario-Based Learning is the process of training through simple simulations as interactive Virtual Scenarios (VS), which mimic real life situations and challenges found in the workplace. In these scenarios learners will work their way through a story line that is usually based around a problem or a presentation of a workplace challenge which they need to solve. These interactive scenarios can offer learners an opportunity to train in ways that are closer to the manner that they will perform in their profession.

SBL can be used to prepare learners for the workplace, using scenarios in a range of different learning activities. Traditionally these activities have been either face-to-face, online or blended approaches. They include lectures, various kinds of role-play exercises, and various forms of flipped classroom activities in which the learner studies the class material before class and then discusses during class.

SBL will function in individual learner activities, but SBL will also work very effectively for group tutorials and discussion groups. When a group is working through a SBL scenario, it can promote a much wider range of discussion and careful thought than is possible with an individual learner. The group can safely explore situations which mimic the challenges and uncertainties that we face in 'real life' and workplace experiences.

For all the activities described above, the type of scenario used is tailored to the learning activity. The two activities which form the basis of this project are both collaborative learning activities: Problem Based Learning and Team Based learning. They are distinct and will utilise different types of scenarios, so first let us consider the types of scenarios we will choose for these activities.

2 Scenario-Based Learning Typography

Scenario-Based Learning (SBL) is an activity which aims to promote learning and awareness by involving learners in realistic situations, often based on real-life situations. It supports a number of active learning activities, including collaborative activities such as Problem-Based Learning (PBL) or Team-Based Learning (TBL).

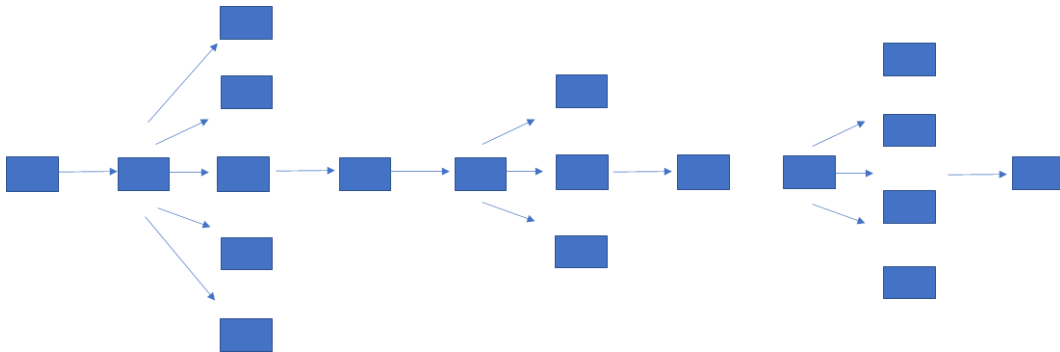
Pedagogically, it is most effective if scenarios permit learners to interact with, and ideally influence, the narrative. With text-based scenarios, the interactivity will normally come from the provision of choices or options for management, or even multiple choice questions. These can occur in several formats, but for the purposes of these learning activities, we will consider three main formats, which



can be promoted in either PBL or TBL. In the following diagrams each blue box represents either a page of text or a point of interactivity or a question, which calls for a decision on the part of learners.

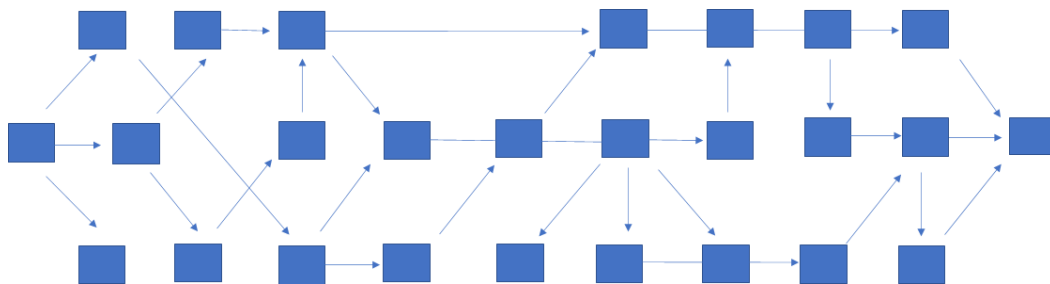
The first format (a) is sometimes termed a ‘string of pearls’. It is a simple structure, with a single straightforward narrative - the middle row. In this example, there are three points of interactivity, which ask questions of the learner, but whatever choice the learner may make the narrative continues unaltered- it is a fixed narrative.

(a)



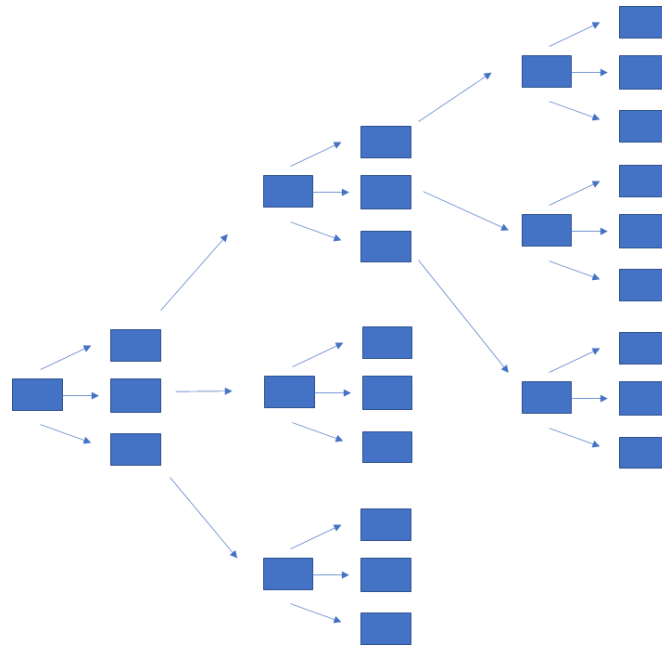
The second format (b) is a branching format. The learner interacts with the narrative and the scenario will unfold according to the choices made. There is usually an optimal path through the scenario, and if the less optimal choices are taken by the learner, it may still be possible to rejoin the optimal narrative, according to how the writer has constructed the case. It is also possible to ensure that all branches finish at the same point.

(b)



The third format (C) is a semi-linear format in which choices may take the learner onto different paths, but those choices do not return in any way to a common path. For example, if you have a decision point with three options, each choice could then lead to, possibly, a further 3 options and so on. (For reasons of space restriction the third set of choices is incomplete below)

(c)



For PBL we have chosen to use type (b), as the most authentic form of scenario, to ensure all learning outcomes are covered by all learners and it is entirely possible to manage PBL online, as we will see. However (b) is not possible in TBL, it is incompatible with the design of TBL processes, and so TBL can use a combination of (a) and a limited form of (c).

3 SBL in Problem Based Learning

Structure of PBL

In PBL, learners work in a group which usually consists of 7- 8 learners, with a facilitator whose role is to provide reasonable guidance where required. Learners normally work their way through a narrative that is based around a problem or a presentation of a particular workplace challenge, which they need to solve. You should not reveal the topic of a PBL scenario to the learners in advance of the session, since initially they do not have significant understanding or knowledge of the problem. As the scenario develops the learner groups will collectively acquire the information presented and be able to apply this through their later self-directed learning, and taught sessions.

PBL can be carried out using scenarios provided on paper, which are ‘linear’, i.e. the learner cannot change the direction of the scenario, and they must proceed in the direction written down in the scenario by the author. Alternatively, interactive online scenarios - virtual scenarios (VS) can be used. We have used an interactive ‘branched scenario’ described in (b) above, and this is termed Decision-Based PBL (D-PBL: Ellaway et al).

Scenario Construction

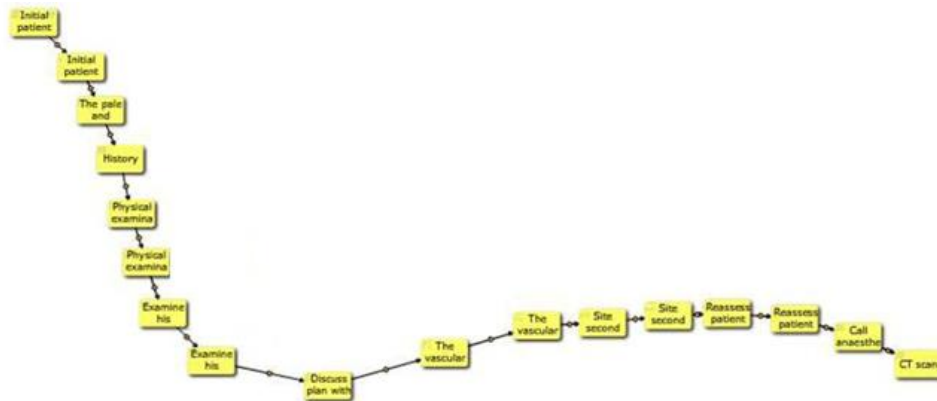


Figure 1: Linear pathway

You can construct a branching scenarios from a narrative or story which already exists in a linear text-based format (figure 1), transferring this online into the VS authoring tool. The simplest procedure would be to create an online version of this scenario, by chopping the case text up into sections that are consistent chunks of information, thereby creating a separate page online (normally termed a ‘node’), of a size that can be projected onto a screen without scrolling, and with reasonable size text, for viewing from a few metres.

At key points in the case, you should then add options from which the learners will be asked to choose, usually at points of action such as; investigation, management or action. These activities should be designed to be realistic and based on evidence as much as possible i.e. situations and challenges that practitioners/trained professionals have experienced; these options may include very poor choices, with possibly disastrous consequences. This approach can apply to practically any competency-based subject.

In the example below (figure 2), each node represents a step in the unfolding of the scenario. Some nodes are connected in simple chains; others have multiple nodes linked to them that allow learners to choose which path they will follow. Learners can only take one path through a scenario and they need to manage with the consequences of their decisions as the D-PBL scenario unfolds. The optimum path is shown in yellow, less favourable paths in blue.

The facilitator encourages learners to consider the options and to debate different courses of action at each D-PBL decision point.

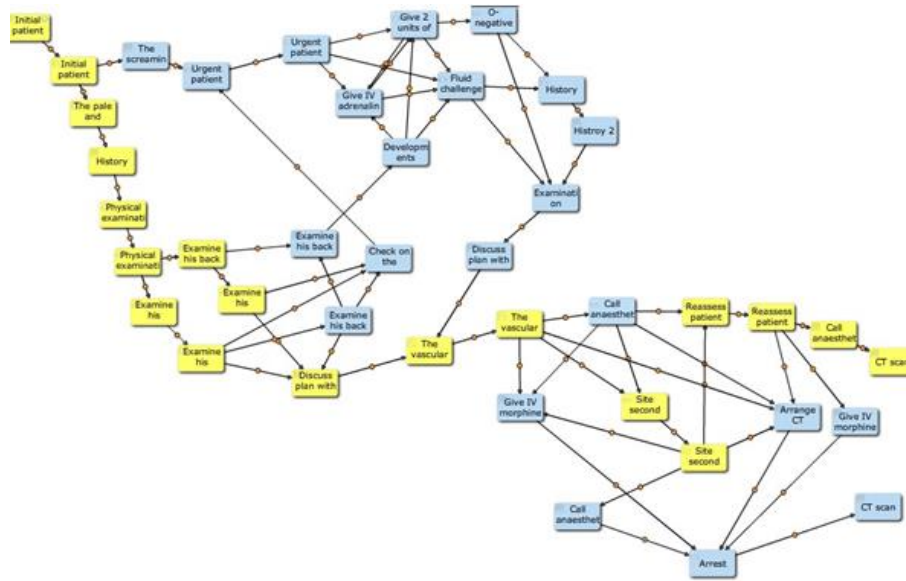


Figure 2: D-PBL pathway

SBL as a collaborative learning tool in PBL

The biggest advantage of the branched VS is that it gives the learners optional routes and directions they can choose to take, while working through the narrative. It is more engaging and immersive, and puts the learners in charge. You can construct scenarios to mimic challenges and uncertainties that learners may face in their future workplace as practitioners, and they thus provide a unique opportunity for learners to practise the critical thinking and clinical reasoning skills that they need to develop as future professionals, and learn from both their successes and their mistakes, without the risk to safety that ‘real world’ training might unintentionally cause. Scenarios should be designed to keep the learners engaged throughout the PBL session, which in some cases can be three hours long. The action in a story must be balanced carefully in order to build suspense as the plot unfolds, so a good story must also trigger empathy: if the learners are emotionally involved in a story they are more likely to remember its message.

Such scenarios are a perfect vehicle for collaborative interactions, learners can share the successes or failures of their choices; the time and energy taken to discuss their choice heightens engagement and emotional impact, in comparison with an individual learner who may make an instant choice and then quickly move forward, with limited concentration and emotional investment, and therefore more limited long-term educational impact. The thoughtful discussion helps to prevent the learners from making poorly thought-out instinctive decisions.

4 SBL in Problem Based Learning: Practice

PBL Process

For online D-PBL a computer, a large screen or smart board, and an Internet connection are required. The web-based virtual scenario is “driven” by a learner, rather than by the facilitator. The following is an example taken from St George’s D-PBL session (image 1). Whilst there are many variants of this process, this approach has reasonably common features, and was the ‘ideal’ model promoted during the TELSON programme.

As each PBL session is relatively long and lasts about three hours there are specific requirements for this type of scenario. Typically, one scenario is tackled each week, with two PBL sessions in the week, one at the start and one at the end. That will leave time for anything from two to five decision points in each section.



Image 1: Set up of a PBL room at St George’s University of London

Role of the learner

The image above (image 1) illustrates how the board, the screen and paper-based resources are seamlessly integrated into the processes of information-gathering and discussion in the PBL group.

At the start of the week one learner is allocated to “drive” the computer while other roles, such as scribe, are allocated or undertaken dynamically.

The scenario is normally introduced at the start of the week, developed further at the end of the week, and then finished at the start of the first session in the following week, before starting the new case.

Within the small-group sessions, the learners work through one page (equivalent to a blue square above - ‘node’, format b) of the VS at a time, taking turns to read the information given to the group. Learners are directed to make notes on the whiteboards in their tutorial rooms, with sections relating to essential case information, points raised in discussion, their analysis/diagnostic suggestions, and any learning objectives they identified for independent study. Learners then pursue the required learning objectives before the next session.

Role of the tutor/facilitator

The tutor has a detailed, paper-based, ‘tutor notes’ version of the scenario which indicates the interactive point within the case, and the impact of each option that the learners may take. The notes are only available to the facilitator. When the learners reach online pages immediately before options are presented, the tutor encourages the learners to declare and discuss the choice of actions that they might take, given the information they now possess. Subsequently, when options are revealed, the tutor encourages the learners to debate the options the group would take (from those presented by the VS) before following the consensus or majority decision.

The tutor manages the group dynamics when necessary, raises issues as set out in their tutor guide, and directs the group to slow down or speed up according to the time available. The tutor decides when to provide triggers and direction, ensures intended learning objectives are being met, helps learners to pace their progression through a case, and encourages debate around decision making at branch points in the case. The tutor also has a map of the scenario, learners will see the map of the case at the end of the tutorial, and discuss all options with the tutor.

The tutor ends the case with a reprise of the major issues and a review of the virtual scenario map showing the different paths they could have taken through the case.



5 SBL in Team-Based Learning

Structure of TBL

Whereas in PBL information is acquired after the session to explain the problem, in TBL information should be gathered before the session and put into context during the group work. Team-Based Learning (TBL) is based on the principles of the flipped classroom, which emphasises learner preparation out of class and then the application of knowledge within class.

Whilst PBL is a free-form non-assessed exploration of a scenario, in TBL the process is more task-focused and assessable. In PBL each group has a facilitator, in TBL the team is not facilitated during the task phases and one or two facilitators will moderate the whole room during discussions, along with a content expert to supply additional information where required.

You should aim to organise learners strategically into diverse teams of 5-7 learners that will work together throughout the session. TBL sessions operate in a three-step cycle: individual prior preparation, in-class 'readiness assurance' testing, and an application-focused exercise.

Learners are tested at the beginning of the TBL session, first individually through a series of basic multiple choice or single best answer assessments in the Individual Readiness Assurance Test (iRAT) then within their teams using the same questions (tRAT). Finally, students work in teams to solve the problems raised during the Application Exercise (AE) which is designed to place the knowledge gained, both before and during TBL, into the context of the workplace or practice. Your facilitators should encourage groups to negotiate and agree a collective response to the application question, and to prompt each group to openly display their answer choice. The facilitators moderate discussions among teams supported by a content expert, who may in some cases be the facilitator themselves.

Construction of the scenario

Ideally you should base your scenarios upon the types of problems learners will encounter as professionals: engineers, doctors, statisticians etc. The four 'S' structure (Michaelsen & Sweet, 2008) is important for creating TBL scenarios and assignments. Only the second point is common to PBL; the reason for the differences is that TBL is a series of independent assessable tasks and PBL is not.

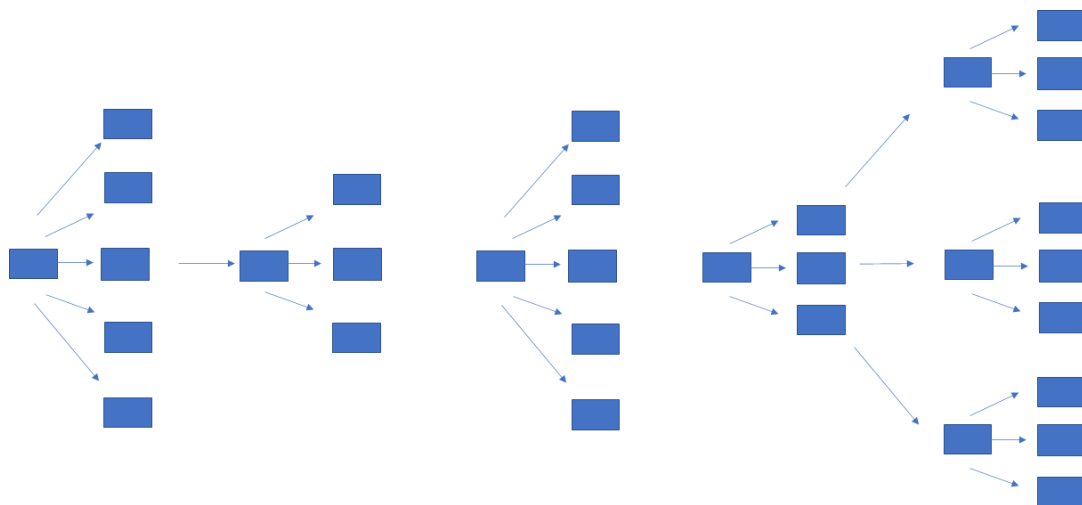
The four 'S' structure:

1. Significant problem: one that asks learners to immediately and meaningfully apply the concepts they are learning and will be using for any related assignments that will follow.
2. Same problem: Groups work on the same problem rather than different pieces of a larger puzzle.
3. Specific choice: Groups are given a specific choice to make rather than asked to answer open-ended questions.



4. Simultaneous report: Groups report their choice in simple form all at the same time.

In all phases TBL can proceed as a simple series of questions, or as a mini-scenario. In effect the most basic form of TBL is as described in (a) under section 2. Sometimes these may just be a sequence of multiple choice or single best answer questions which have no narrative connection to each other, sometimes the questions can be weaved into an integrated narrative or story. In this model below, the application phase has been allowed to branch (the 4th and 5th decision points), so that discussions are left until the end, and in this case there are nine potential answers solutions, not three.



6 SBL in Team-Based Learning: Practice

TBL process

The TBL process consists of several stages: initial arrangements, pre-class preparation and in-class activity. The content and arrangements of TBL sessions, roles of facilitators, experts and students, and physical layout (disposition) all differ from PBL.

The initial arrangements

These involve arrangement of the venue and the formation of learner groups. A large hall/room is required, to accommodate several tables, with 5-7 learners at each table each of whom will need space for their devices. The total number of tables depends on the number of learners on the course; the hall will need at least 2-3 smart boards and Internet connection including wifi.



Figure 1 below shows an example of a potential room layout, with tables equally spaced in a large room with wall-mounted smart boards being clearly visible and image 2 shows an example of TBL taking place at Lee Kong Chian School of Medicine, Singapore.

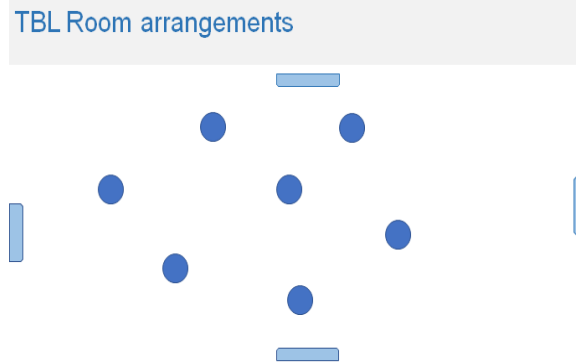


Figure 1: PBL room layout



Image 2: photograph showing a TBL session taking place, courtesy of [Lee Kong Chian School of Medicine, Singapore](#)

The construction of TBL teams must not be a random process. Each team should be balanced to include a combination of learners with different characteristics and learning experience. The purpose of creating a diverse team is to achieve a better collaborative learning experience.

Pre-class preparation

During pre-class preparation, the learners are given learning outcomes (in contrast to PBL) for each topic, indicating what learners are expected to learn from the assigned material. They are also provided with the assigned learning material for pre-class preparation, ranging from: narrated PowerPoint sessions, online videos, images, journal articles and so on. Learners should study this material before the session.

In class activities: Role of the learner

The learners should join their groups having done the pre-preparation and therefore be familiar with the topic to be covered. Once at the table learners pass through two main stages/steps in TBL. The first stage is the Readiness Assurance Process (RAP), which consists of two assessments or tests, the Individual Readiness Assurance Test (iRAT) and the Team Readiness Assurance Test (tRAT).

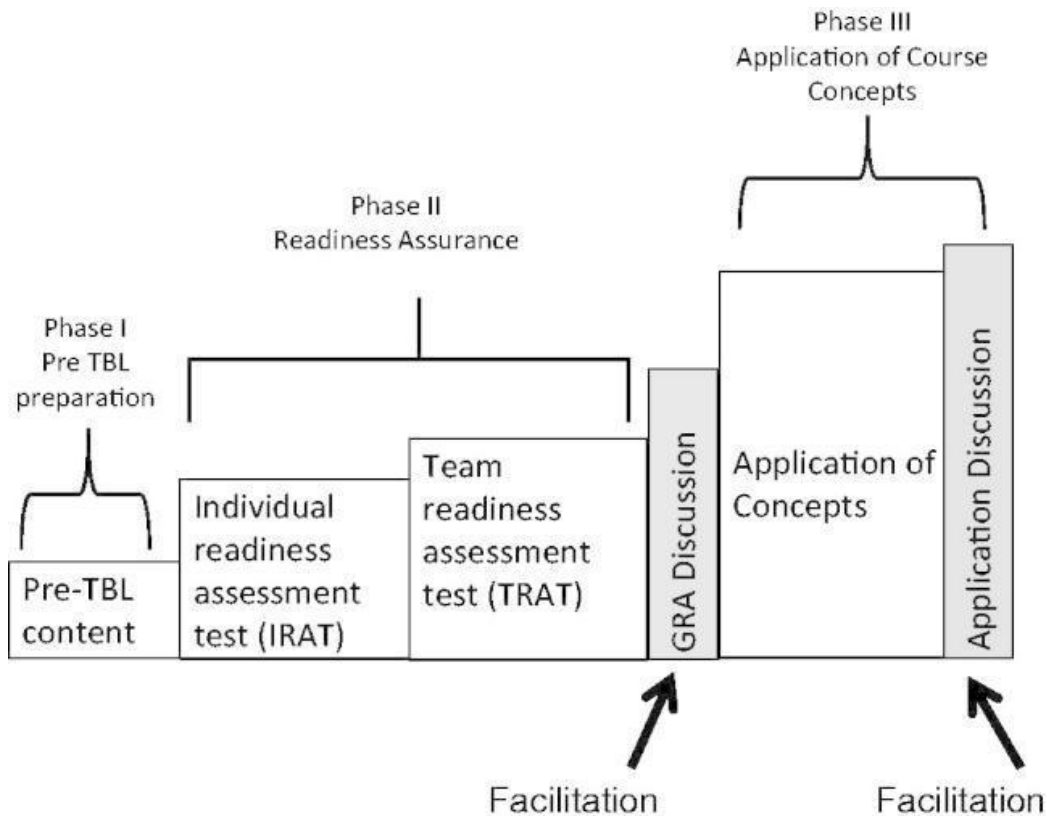


Figure 2: Twelve tips for facilitating team-based learning, *Med Teach*. 2015 Sep 2; 37(9): 819–824

The purpose of the first step (iRAT) is to hold learners accountable for their understanding of TBL preparatory material and to assess their understanding of the subject on an individual basis. The

Individual Readiness Assurance Test (iRAT) is usually a series of MCQs/SBA questions, each of which can be independent or integrated into a continuous scenario. Learners, while sitting in their groups, each carry out this test independently. The questions and scenarios focus on important concepts from the pre-class preparation. Timing is limited to 10-30 minutes depending on the amount of questions, and their answers are now logged, either electronically or on paper.

Next, the team-based Readiness Assurance Test (tRAT) follows. The team must now answer the same questions they answered as individual learners in the iRAT. However, this time they discuss them collectively with team members. Once the decisions are taken the teams should be asked to declare their choice, and in the general discussion that follows, must be prepared to discuss and defend their choices. The discussion should be managed by the facilitator and then followed by immediate feedback, given jointly by the facilitator and content experts. The iRat and tRAT can be carried out either on paper or on laptop/tablet.

The second stage in the TBL process is the Application Exercise (AE). The AE can be constructed in different ways: AE assignments could be arranged in different formats: (i) as a set of MSQs and/or SBA questions (ii) Scenario based (iii) as a mix of independent questions and a virtual scenario (MCQ, SBA and VS).

The aim of this part of TBL should be to apply the concepts learnt, to reinforce the key concepts and to give insight into authentic problems that learners could encounter as professionals. The learners work as teams, come to a decision on the best answer, then present and debate their choices.

The AE can be either an open or closed book exercise, with time limited to 1.5- 2 hours.

[In-class activities: role of the facilitator and expert](#)

Facilitators and content experts have different roles in the TBL process.

The facilitator is usually an educator who is an expert in the TBL process. Their main role is to follow the TBL process and facilitate productive discussions between learners.

A content expert is usually a subject matter expert with the knowledge and skills in the studied area or an educator specialising in this area, who has a deep understanding of the subject matter. A Content Expert is involved/responsible for assigning the preparation materials, development of a set of questions and/or learning objectives that are essential to the learning topic.

Both (a facilitator and a content expert) should be involved in the discussion at the end of tRAT and end of AE discussion though their roles are different (see Figure 2).

The aim of the facilitation after the tRAT is to reflect discussion within teams, while the teams present their answers and ask each other questions. Facilitated inter-team discussion is held to address the questions, identify uncertainties and clarify them. If there are any concepts that learners cannot resolve through the discussion with their classmates, content experts are there to help.

A facilitator should moderate the discussion at the end of AE. Here they would facilitate class-wide debates around the learners' decisions following the TBL teams presentations justifying their



answers. The main goal of facilitation at this stage is to encourage teams to justify their decisions and to critique and debate each other's answers.

At the end of the AE debates and feedback, the content experts provide a summary and present a list of closing statements, representing important aspects of the learning which occur through the entire TBL session.

7 Technology

The technology required for the PBL process is outlined in section 4; PBL process. Section 6; the initial arrangements outline the requirements for TBL set up.

Background to the technology

Most scenario systems include an authoring tool and a scenario player, with some form of simple assessment. There are three main categories of systems:

1. Fully functional, server-based tools, which can collate data for assessment, for counters, for individual and group analysis, and a wide range of functions. Require institutional/technological support and a strong commitment to SBL. Some of these are freely available, others require commercial licences. The system used in both our PBL and TBL in our programmes is OpenLabyrinth, others are available on subscription bases, such as Campus and Decisionism.

As an alternative with less requirements for institutional support there are two other groups of possibilities, which are more device based than server-based tools and therefore with less functionality for maintaining individual identity, and with limited assessment tools.

2. Freely available Web and device-based systems, designed for story-telling and gaming, which are simple to use: for example, Twine, Squiffy and Visual Understanding Environment (VUE). Each allows the creation and sharing of scenarios, but group logins are an issue, and assessment functionality is limited.
3. More 'simple solution' systems, but ones which require a subscription. There are several of these such as Articulate or Branch Track. Again, there is limited assessment functionality.

Most of the above systems can be used in Problem-Based learning, but TBL requires both personal and group identities, and a recorded assessment system.

The tool used for both PBL and TBL in this project is OpenLabyrinth.

OpenLabyrinth (OL)

OL is a freely available, open source software system for authoring and delivering Virtual Scenarios. It is specifically designed to allow authors to create scenarios that are branched and have learners



making choices. The system makes it easy to create scenarios and visualise the decisions to be made by learners by providing a visual editor, in which the scenario can be represented as a network diagram, or decision tree. Today the strategic direction of OpenLabyrinth is provided by the OpenLabyrinth Development Consortium, led by the University of Calgary.

Since OpenLabyrinth is a web-based system, the only technical requirements for learners to play a scenario are a web-browser and Internet connection. For those who want to try authoring Virtual Scenarios, OpenLabyrinth can be installed on a basic web server running Apache, MySQL, and PHP.

OpenLabyrinth is particularly well-suited to creating scenarios designed to be used by groups, and for learning activities such as Problem-Based Learning. The branched scenario design can be used to provide very effective feedback to learners as part of the changing narrative of the scenario. Authors can also include scoring elements and free-text or multiple choice questions.

Guidance on the use of OL can be found here:

<http://www.wavesnetwork.eu/res/file/mooc/openlabyrinth-detailed-guide.pdf>

8 Summary

Both TBL and PBL can benefit from scenarios.

The PBL scenario is a richer medium of interactivity, with its options/choices and decisions, as benefits of the open ended nature of PBL. Its focus is on information gathering and developing critical reasoning.

TBL is a more controlled, task-based process, and its focus is more on assessment as checks of progress, and putting knowledge in context. Because TBL is more of a series of single accessible steps, with all learners in step, (i.e. reaching the same point at the same time, whereas PBL is an individual group experience) it cannot have the flexibility of the PBL interactive scenario and it cannot reproduce the real-life authenticity of making choices and having to deal with the consequences of those choices.

Both have their advantages. PBL has an approach which allows greater exploration of subject matter, and a more authentic experiential unfolding of a workplace scenario. It was borne out of an era of high decision-making.

“The key to good decision making is not knowledge. It is understanding. We are swimming in the former. We are desperately lacking in the latter”. (Malcolm Gladwell, *The Power of Thinking Without Thinking*, 2005, pub: Hachette Audio).

TBL has a greater focus on exploring and applying the information learners already have accessed. It arose in an era of instant information, and information overload.



“Getting information off the internet is like trying to take a drink from a fire hydrant” (Mitchell Kapor, 1991, in conversation).

In practical and pragmatic terms, the TBL process has more significant advantages for educational leaders, with less staff needed, and more built-in assessment.

Each delivery mode should be assessed and applied as per the requirements of the learning activity.

9 References

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Mitchell Kapor, 1991, in conversation

