



## Considering modes of delivery in blended PBL: a literature-based approach

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The COVID-19 pandemic had accelerated Blended Learning in many institutions worldwide, catapulting it into a now permanent spot in the school curriculum in many higher learning institutions. However, given the infinite permutations in blended learning, it is not surprising that it has led to contradictory student outcomes and learning experiences. Research has suggested the combination of Problem-based learning and blended learning can lead to constructivist learning environments that promote 21<sup>st</sup> century skills such as innovative uses of technology, problem-solving and collaborative skills. However, there is little to guide educators in the design of blended PBL. One design consideration is the choice of delivery modes. In this presentation, the literature is explored for the essential instructional components in PBL, and the modes of delivery that best support them. This could be offered as a starting point to support lesson designers approaching blended PBL.

Keywords: Problem-based learning, Blended learning, Blended PBL, instructional design

### Introduction

The COVID-19 pandemic has been said to have accelerated blended learning. In many countries, including in Singapore, blended learning has now been said to become a new constant in the school curriculum (Lim & Graham, 2021; Ng, 2021). However, clear and concise design principles for creating instructional activities for blended learning seem to be lacking in the literature (Boelens et al., 2017). The literature suggests a promising approach in the use of blended problem-based learning (PBL), where learning is initiated and anchored by an authentic problem (Boud & Feletti, 2013), and delivered through blended learning. Firstly, blended PBL has been said to offer a constructivist learning environment (An, 2013). Secondly, it enables the benefits of learning through both online and face-to-face modes where they are best used (Donnelly, 2017). Thirdly, it encourages innovative uses of online tools and new technologies that can enhance the PBL process (Donnelly, 2017; Ryberg 2019). However, there have been few studies on blended PBL, that have paid close attention to its design process (An 2013; Donnelly, 2017). The purpose of this paper is to review existing literature on various blended learning delivery modes and, through the investigation, suggest suitable modes of delivery in blended PBL for higher learning institutions, such as polytechnics, colleges and universities. It is guided by the research question: Based on a literature review of PBL and blended learning research from 1996 to 2021, which modes of delivery best support each key component in the blended PBL process?

### Literature Review

#### The Key Components in Problem-based Learning

PBL has been adapted to suit various disciplines, levels and contexts since its early roots in medical education. In designing PBL, there are no fixed and universal set of practices which must be followed (Barrows, 1996; Boud & Feletti, 2013). However, there are core components that seem key to the PBL process. These are six components gleaned from the literature:

##### *Component One: A 'Problem'*

The PBL process typically begins with students being presented with a problem scenario to initiate the learning process (Barrows, 1996). An effective PBL problem is (i) stimulating, so that students are invested to explore and investigate concepts and ideas to solve them (Boud & Feletti, 2013), (ii) authentic, mirroring real-world problems (Boud and Feletti, 2013), (iii) transdisciplinary, to enable students to learn in relevant and connected ways (Duch et al., 2001), and (iv) ill-structured, to encourage students to explore, discuss and adapt their knowledge (Loyens et al., 2011).

*Component Two: Teacher as Facilitator*

In PBL, the teacher's role is to guide learners to sharpen their cognitive skills, to collaborate and solve problems, in so doing reaching deeper levels of understanding in their subject areas (Hmelo-Silver, 2004). She may toggle flexibly between scaffolding strategies such as giving feedback, question prompts, hints, and expert modelling (Hmelo-Silver, 2005) or even direct instruction such as mini lectures, when the need arises without necessarily fixating on the right or wrong answers (Hmelo-Silver et al., 2007). It is a role centred on mutual respect and independence (Barrows, 1996).

*Component Three: Collaborative Learning*

Peer collaboration is a significant component of the PBL process. Collaborative learning in small groups introduces a social dimension into the learning process (Hmelo-Silver, 2004). When learners engage, coordinate and work purposefully towards a common goal, they naturally interact, verbalise and dialogue through their learning process together (McCaughan, 2015). Group work helps to distribute the cognitive load in a team making learning more manageable (Kirschner et al., 2011).

*Component Four: Self-directed Learning*

Self-directed learning is encouraged in PBL as opposed to being fed information or by being instructed by a teacher (Barrows, 1996). Self-directed learning is triggered, for example, when students identify gaps, hypothesise, and devise solutions to the given problem (Hmelo-Silver, 2004). These arm them with problem-solving skills for the real world.

*Component Five: Assessment*

Hmelo-Silver (2004) and Loyens et al. (2011) summarised the goals of PBL into five main objectives – for students to (i) construct an extensive and flexible knowledge base (ii) become good collaborators (iii) become motivated to learn (iv) become self-directed learners and (v) develop problem-solving skills. These objectives cover both the process and product of learning. The assessment of students' achievement in PBL should thus be done using both formative and summative methods that covers both learning and performance (Boud & Feletti, 2013; Duch et al., 2001).

*Component Six: Synthesis and Assimilation*

In PBL, reflection is a key metacognitive skill that helps in the process of synthesis and assimilation (Hmelo-Silver, 2004). Barrows (1986) described it as getting learners to re-examine all facets of the process to better understand what they know, what they learned and how they performed. The conscious act of synthesising and reapplying new knowledge to the original problem and evaluating their learning processes consolidates understanding (Boud & Feletti, 2013).

**Determining Delivery Modes in Blended Learning***Modes of delivery in Blended Learning*

Blended learning is defined as the combination of face-to-face with computer-mediated instruction (Bonk and Graham, 2006). The literature often discusses three broad modes of instruction used to deliver blended learning. These are face-to-face instruction, synchronous online instruction and asynchronous online instruction (Bonk & Graham, 2006).

*Determining the modes of delivery in blended learning*

Blended learning works when the modes of delivery complement each other (Alberts et al., 2010; Yukawa, 2010). These combinations need to be constantly evaluated to suit the environment as well as teaching and learning needs (Fuller, 2021). Two theories are suggested here that may aid in the selection of delivery modes in blended learning. They are (i) the Media Richness theory, a concept developed by Daft & Lengel (1986), which continue to be employed in communication and education research such as Sun and Cheng (2007), Balaji and Chakrabarti (2010) and Ku et al. (2021); and (ii) the Media Synchronicity theory (Dennis et al., 2008), a theory that has been employed in e-learning literature such as Samardzic et al. (2014) and Tang and Hew (2022).

The media richness theory recommends the delivery media based on its degree of 'richness' (Daft & Lengel, 1986). On one end of the spectrum, a 'rich' media can accomplish four goals. It can (i) send multiple signals such as nonverbal cues (ii) support language variety such as slang (iii) provide immediate feedback from the receiver and (iv) allow for the tailoring of messages in a real-time situation. Some examples of rich media are face-to-face sessions or online video conferences. They are best for activities where there are multiple interpretations or conflicting solutions. On the other end of the spectrum, less rich media are best for activities that can do with delayed feedback such as asynchronous discussion forums.

The media synchronicity theory considers all communication tasks as composed of two fundamental processes: conveyance and convergence (Dennis et al., 2008). Conveyance processes, such as giving instructions to students, are better done asynchronously. Convergence processes such as discussion or debates where there are divergent ideas, are better done synchronously.

A summary of these two theories and how they can guide the decision-making process in determining activities in blended learning, is offered in in Figure 1.

Media richness theory (Daft and Lengel, 1984)	Less Rich Media	Rich Media
	<b>What it means</b> Media with less rich sensory input, delayed feedback or shared focus <b>What it supports</b> Unequivocal Learning Tasks: Learning tasks with low haziness such as learning factual knowledge <b>Examples</b> Online discussion boards	<b>What it means</b> Media with richer sensory input, immediate feedback or personal focus <b>What it supports</b> Equivocal Learning Tasks: learning tasks with multiple or conflicting interpretations or solutions <b>Examples</b> Face to face meetings

Media synchronicity theory (Dennis et al., 2008)	Conveyance	Convergence
	<b>What it means</b> Low dependency of time and location and different modes of communication <b>What it supports</b> Learners work and share information regardless the constraints of time and place. Learning is more reasonably designed for conveyance, that is, the exchange of information. <b>Examples</b> Relaying information. Sharing resources.	<b>What it means</b> High dependency of time and location and different modes of communication <b>What it supports</b> Learners work together with a shared focus at the same time and place. Learning should be designed to facilitate a convergence process that reaches a common understanding <b>Examples</b> Face to face project work

**Figure 1. Two theories for determining delivery mode and media in blended learning**

### Suggestions on Delivery Modes in Blended PBL

In this section, the media richness and the media synchronicity theories are mapped out to the six key components in PBL to produce a set of suggestions for the delivery models that can support blended PBL.

#### *Component One: A ‘Problem’*

The problem scenario is often given to the students before or at the start of the PBL process. This seems to fit the description of a conveyance activity (Dennis et al., 2008). It does not require “rich” media where immediate feedback or personal attention is crucial (Daft & Lengel, 1986). Thus, for a blended PBL approach, it is proposed that the release of the problem scenario can be done online and asynchronously. The lecturer can put up the problem statement online for learners to access at their own time. This gives the flexibility of time and space for students to access and process it, which is one the advantages of blended learning (Boelens et al., 2017; Staker & Horn, 2012).

#### *Component Two: Teacher as Facilitator*

In PBL, the role of the teacher is to guide and coach the learner through the learning process (Barrows, 1986). In “rich” face-to-face classes, lecturers are able to observe and react to non-verbal cues, address concerns and provide immediate feedback in real time (Daft & Lengel, 1986). This could be especially helpful for convergent activities where students may need to work through a divergence of ideas (Dennis et al., 2008). Online learning on the other hand, presents a large range of communication tools which allow for flexibility without being bound by geography (Ryberg, 2019). For a blended PBL approach, this study suggests that facilitation is done throughout the PBL process on face-to-face and online synchronous and asynchronous platforms. This gives the lecturer presence and the flexibility to customise the timing and degree of scaffolding for students where they see fit. For example, teachers can meet students face-to-face or online synchronously on video call to work through any perturbations they may have about the problem scenario, for which there are conflicting interpretations that need to be guided through (Daft & Lengel, 1986). They can also facilitate asynchronously via online platforms like discussion forums or chat groups where they can observe ongoing discussions without necessarily participating in all of them (Savin-Baden, 2007). This is aligned with Andersen et al. (2021)’s study which found that in online PBL during the COVID-19 pandemic, students enjoyed the flexibility of one-way activities like online lectures, but sought more facilitator interaction when learning became active and social.

#### *Component Three: Collaborative Learning*

The wide range of opportunities for interaction in blended learning is valuable to learners (Yukawa, 2010). Face-to-face sessions are useful for intensive and challenging tasks where convergence of thoughts and ideas are the focus (Daft & Lengel, 1986). On the other end, asynchronous mediums are useful for conveyance processes (Dennis et al., 2008). Blended learning allows for learners to reap the benefits from both types of interaction (Bonk & Graham, 2006). For these reasons, this paper suggests that collaborative learning activities in blended PBL are done on face-to-face and online synchronous and asynchronous platforms. For example, in between

“rich” face-to-face meetings, students can learn collaboratively by sharing their thoughts and ideas asynchronously via discussion boards and chat groups.

#### *Component Four: Self-directed Learning*

Technology has made it easy for learners to find resources on their own (Ge & Chua, 2019). With this access, they can be encouraged to explore concepts, thoughts and ideas and decide on their own pathways, space and time (Staker & Horn, 2012). In the blended PBL approach, this paper recommends that self-directed learning activities be done online asynchronously. For example, they could be encouraged to research ideas related to the problem scenario through a series of activities that they could do on their own. Learner independence and autonomy are core to successful blended learning courses (Alberts et al., 2010).

#### *Component Five: Assessment.*

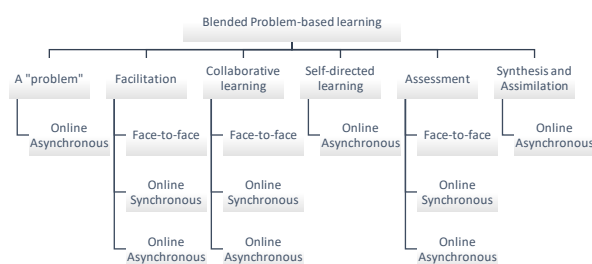
Assessment in PBL is holistic and concerns both the process and product of learning (Boud & Feletti, 2013; Duch et al., 2001). For the blended PBL approach, this study proposes that assessment activities are done on face-to-face and synchronously and asynchronously on online platforms. For example, formative activities that involve feedback, adjustment, refocusing and coaching can be done face-to-face or through online consultations with the facilitator, as well as asynchronously through pre-set self-paced quizzes and games. Assessments that are more time-sensitive could be done during the face-to-face components on the blended PBL approach. This is especially if the assessment involves multiple solutions or requires immediate feedback such presenting problem solutions.

#### *Component Six: Synthesis and Assimilation.*

The reflection process consolidates the learning process (Savery, 2015). In this way, it is an introspective activity where students can potentially value flexibility in time and place. In the blended PBL instructional approach, this study recommends that synthesis and assimilation activities such as reflection activities are done online asynchronously. For example, this can be done through online platforms like email, text chat or discussion forum. These asynchronous online tools provide the benefit of flexibility as students can participate in these activities at periods that are convenient to them.

## Conclusion

This research set out to suggest the suitable modes of delivery that can support blended PBL based on the literature. First, the six essential components of PBL were drawn out from the literature. Next, two theories were discussed that may aid in the selection of delivery media in blended learning. The two were mapped out to produce a set of suggestions for how the different components in PBL can be delivered in blended learning. This study’s limitations include the lack of literature that examines the outcomes of these suggestions in the context of blended PBL. Future directions include the implementation of these suggestions to test and explore the outcomes and experiences from both the teacher and learner perspectives. Nevertheless, it is hoped that this offers a starting point to support lesson designers approaching blended PBL. Figure 2 presents a summary of the suggested modes of delivery that supports blended PBL.



**Figure 2: Suggestions for modes of delivery in blended PBL**

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