Problem-based learning: a review

Problem-based learning is a pedagogical approach whereby issues are described within a scenario to enable students to identify their own learning objectives (Wood, 2003). Typically, scenarios are patient based and the process of creating learning objectives aims to help students develop their problem-solving abilities while simultaneously building upon their basic and clinical scientific knowledge base. This article outlines the concepts that led to the development of problem-based learning, discusses its utility as a teaching method, describes the structure of the problem-based learning process and provides guidance on how facilitators can effectively coordinate problem-based learning sessions.

Why was problem-based learning created?

In the late 1960s, the newly formed medical school of McMaster University in Canada introduced problem-based learning as a novel teaching concept focusing on 'hands-on' learning (Neville and Norman, 2007). This unique approach with its emphasis on student-centred, self-directed learning would constitute the foundations of McMaster's curriculum and separate it from its predecessors. Before the development of problem-based learning, a recurring theme from the undergraduate experience of students was that the initial years of their course were often considered impractical with students struggling to see the relevance of topics such as anatomy and physiology to their future careers as clinicians (Schmidt, 1983). Problem-based learning was designed as a solution to this, aiming to demonstrate the relevance of the subject matter by applying it to realistic scenarios.

Problem-based learning represents a move away from a traditional lecture-based didactic approach to a student-centred approach. Such an approach is theorized to permit a constructivist attitude to learning where students create frameworks to organize and retrieve appropriate information (Davis and Harden, 1999). Problem-based learning sessions are often rated as being highly enjoyable by both students and staff (Kilgour et al, 2016) and it is suggested that this may in turn lead to higher motivation levels for all involved.

Problem-based learning's increasing uptake

Almost 50 years after McMaster University's concept was introduced, problem-based learning has spread worldwide (McKendree, 2010). In the UK, the first medical school to operate a curriculum built around problem-based learning was the University of Manchester in 1994 (O'Neill et al, 2000). Since then a number of UK-based medical schools have either incorporated problem-based learning into their curricula or moved towards curricula structured entirely around problem-based learning. Pure graduate entry medical courses have also successfully used problem-based learning in a number of universities and countries (McCrorie, 2001; Elliott and Epstein, 2005). This appears an entirely logical move, taking advantage of the breadth of experience that graduates bring to medicine and consequentially harnessing their motivation for self-directed learning (Carter and Peile, 2007; Elzubeir, 2009).

Does problem-based learning work?

Following on from the widespread implementation of problem-based learning in medical school curricula, studies have attempted to assess its utility as a teaching method for tomorrow's doctors.

Knowledge retention and exam performance

Studies comparing problem-based learning and traditional lecture-based curricula in terms of knowledge retention and exam performance have thus far been inconclusive. Some report that problem-based learning is more effective (Zhao and Potter, 2016) while others report no significant difference to lecture-based education (Herzig et al, 2003; Khobragade et al, 2016). It has been postulated that motivation, learning skills and study methods used by students are likely to be more important factors in exam success than problem-based learning (Feeley and Biggerstaff, 2015). The superimposition of such factors on the initial questions at hand makes it difficult to make firm conclusions about problem-based learning directly in comparison with traditional teaching methods.

Student satisfaction

Another important measure of the effectiveness of a teaching method is student satisfaction. Most studies have demonstrated that problem-based learning is generally well received (Kilgour et al, 2016). Some factors identified as components key to successful problem-based learning include small group size, using realistic, rather than textbook, case scenarios and managing group dynamics (Kilgour et al, 2016). These are important for facilitators to consider when designing and using problem-based learning based courses.

Social and communication skills

One of the major benefits of a curriculum centred on problem-based learning is that it seems to confer more confidence in social and communication skills to graduates (Miles et al, 2017). This finding is in line

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with other reports of greater confidence in cognitive and social skills noted by graduates and supported by observed assessments (Koh et al, 2008). However, when graduates are asked to report their confidence in knowledge-based competencies, problem-based learning courses do not appear to confer greater confidence. In fact, problem-based learning graduates may report feeling less knowledgeable (Cohen-Schotanus et al, 2008; Koh et al, 2008). It appears that students of problem-based learning courses fear that their self-directed study lacks the depth of that covered in expert lectures. Further studies are needed to ascertain the reason for this but this may be attributable to the student-centred approach favoured by problem-based learning. This presents an interesting challenge for facilitators whose aim is to encourage students to speak freely and have confidence in their knowledge base.

The debate continues

Although problem-based learning has been widely adopted in both undergraduate and postgraduate medical education, the effectiveness of problem-based learning is still debated. This may reflect the methodological difficulty encountered when comparing it with traditional lecture-based curricula. Nevertheless, when the thought process that led to the development of problem-based learning is taken into account, one can see why uptake has continued to increase leading to it becoming a mainstay in medical education. Therefore, it is vital for any clinician interested in teaching to understand its methodology.

What is the problem-based learning process?

Problem-based learning sessions are usually delivered as small group tutorials consisting of around 8–10 students and a facilitator. The role of the facilitator is to assist the process rather than to teach students (Schmidt et al, 2011). Over the course of two sessions, students will work through a patient-based scenario using the Maastricht 7-step process (*Figure 1*). While other frameworks exist, this process is the one that is most commonly used to facilitate problem-based learning. Its exact composition is likely to vary among institutions.

Generally, the first session covers steps 1–5 and involves the delegation of a chair and a scribe within the group. The student designated as the chair leads the session. The scribe will document the students' thought process. The outcome of the first session will be to identify learning objectives which students will go away and independently study. In session two, students discuss the products of their independent study in person. This facilitates an exchange of information and ideas where students are able to question and teach their colleagues. The chair has an important role, ensuring that all objectives are covered and that all students participate. The chair also contributes his/her own independent study findings to the discussion. The facilitator oversees the process ensuring that the students remain on topic throughout sessions and providing guidance where needed.

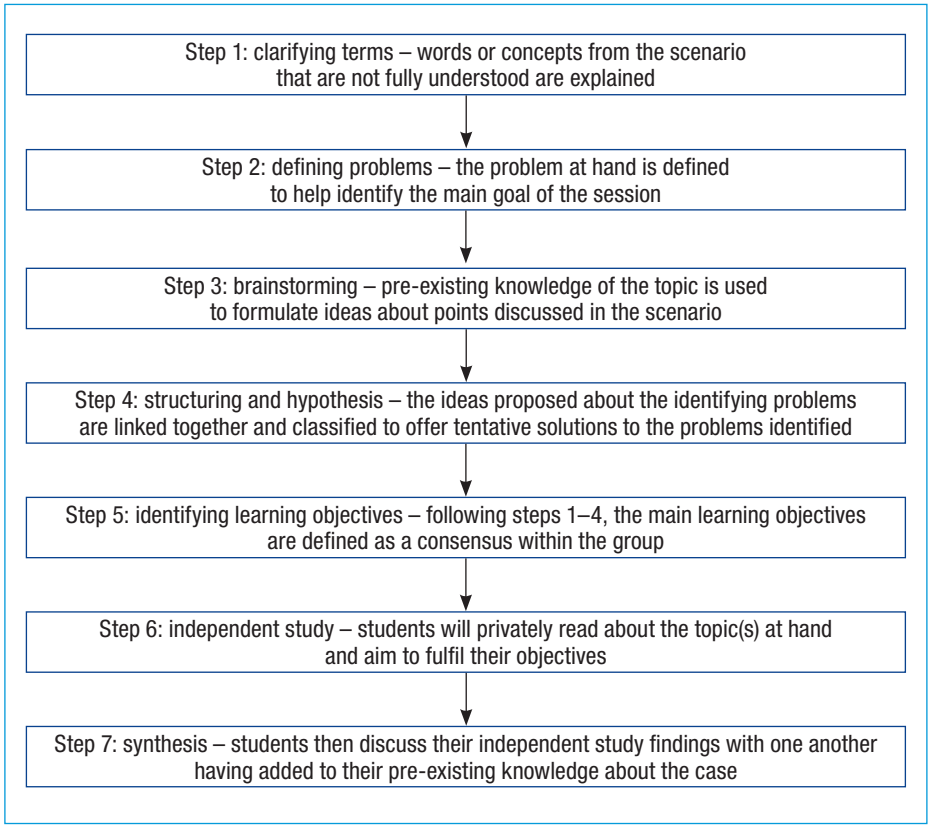

Figure 1. Maastricht 7-step process. Adapted from Schmidt (1983).

Before the second session which occurs a few days later, students can use social media platforms such Twitter and Facebook to communicate and further their learning in conjunction with traditional learning resources such as books and journals. While the exact role of social media in problem-based learning is yet to be fully clarified, anecdotal evidence thus far has demonstrated the potential benefits that platforms such as Twitter offer (Lasker and Vicneswararajah, 2015). One major benefit highlighted was that questions that students had in between sessions could be posted online. Students and tutors could then answer questions before the session and/or discuss further during the session. More challenging questions could also be circulated to other specialist consultants facilitating further discussion and participation.

Tips for doctors

The increasing use of problem-based learning over the past few years has created a unique problem. Often facilitators base their teaching around their own previous learning experiences. However, owing to its relative novelty many facilitators are not acquainted with the process of problem-based learning. As such it can prove daunting for clinicians to act as facilitators.

How to approach the role of facilitator

The requirement to facilitate learning rather than didactically teach (Maudsley, 1999) can make it difficult for facilitators to adapt to an unfamiliar role. This can be challenging for clinicians, especially if the subject area is one they are knowledgeable in. However, a reminder of the thought process behind

TOP TIPS

- As a facilitator, it is important to be aware of the fact that students may initially be apprehensive when participating in a problem-based learning session. Ask open questions and allow students plenty of time to encourage participation.
- Obtaining feedback from students and fellow medical educators is extremely useful for subsequent development as a facilitator.
- As a learner, one can use the learning objectives and any additional resources provided by the medical school to guide and optimize learning.
- Small group sessions offer problem-based learning participants an opportunity to teach other group members. This can benefit the participant teaching as it encourages them to learn particular topic(s) in depth. Other group members can also benefit from being taught by their colleagues.

the development of problem-based learning should deter clinicians from this. Indeed, a major component of problem-based learning is that the facilitator need not be an expert in the field being discussed. A facilitator could be a junior member of staff, provided that he/she is capable of guiding students through the problem-based learning scenarios. This can present another problem in that facilitators may feel underprepared for sessions. Often there are tutorial notes to help with this. The learning objectives created for each problem-based learning scenario will vary from group to group. However, there will be some key areas to cover in each problem-based learning session, linked to curricula learning outcomes. These will often be presented in the tutorial notes along with a brief explanation aimed at non-expert facilitators. This allows the facilitator to monitor whether key curriculum areas are being missed and help steer the group towards these areas.

The facilitator's level of expertise and its impact on student performance is an interesting area of study. A study by Schmidt et al (1993) reported that students guided by subject matter experts tended to achieve more academically. More recent studies have refuted this, reporting no difference in academic achievement between expert-led and non-expert-led sessions (Steele et al, 2000; Kwizera et al, 2001). Irrespective of the prospective facilitator's knowledge base, observing an experienced colleague facilitating a problem-based learning session can be an extremely valuable exercise. This can provide medical educators with a framework to build upon for their role as a facilitator of problem-based learning.

Dealing with small group dynamics

In order to deliver problem-based learning sessions successfully, medical educators need to be familiar both with problem-based learning (in order to act as a facilitator) and with 'small group teaching'. This is defined by the Higher Education Academy as a session where 'dialogue and collaboration within the group are integral to learning' (Mills and Alexander, 2016). This statement emphasizes the interactivity of such teaching sessions. This offers a number of benefits to students, enabling them to engage far more than they would with more conventional teaching methods. This allows debates to ensue and conflict to be dealt with.

Drawing upon Piaget's theories regarding cognition, this type of teaching allows cognitive development to take place (McLeod, 2015). However, prospective facilitators must also be wary of the challenges posed by facilitating small group sessions. Students can become overly dominant within a group, which can prove detrimental to the learning of other group members. This can adversely affect group dynamics and facilitators must be aware of strategies available to deal with such issues. These include:

- Setting ground rules with students at the beginning of a session. The rules help create an atmosphere of mutual respect and can be referred to or amended in the future
- The facilitator can encourage student policing of the group by supporting the chair. The role of chair may be new to the student, so it is important that he/she has an empathetic facilitator to assist him/her
- A last resort would be for the facilitator to take back the traditional role and speak to the troublesome students as a tutor.

Some universities alter the problem-based learning groups allowing students to work with a greater number of colleagues and facilitators. This can also disrupt particularly challenging groups.

Critical appraisal

It is essential for an individual to be able to reflect on his/her problem-based learning sessions to permit further development of the teaching methodology. The concept of Brookfield's four lenses aims to harness an individual's teaching from a number of vantage points (Brookfield, 1987). A teacher can learn from his/her own autobiographical experiences, students' feedback, colleagues' experiences and by reviewing the literature. By drawing on all of these sources of information, a teacher can take measures in subsequent teaching sessions to improve his/her standards of practice. This can be taken further by asking another facilitator to sit in on the sessions and give feedback. A careful critique of teaching methods both internally and externally will allow medical educators to become effective facilitators of problem-based learning.

Conclusions

This article provides an overview of problem-based learning and advice on how facilitators can coordinate sessions. It should be seen as an introduction to the concept of problem-based learning, enabling clinicians to effectively facilitate sessions should they be asked to do so. Some of the potential pitfalls of problem-based learning have been discussed and it is hoped that some of the advice provided in this article will help prospective facilitators avoid these issues. While this article was written with the aim of providing tips specifically for problem-based learning, there is no reason why these skills cannot be used in other educational settings. The skills acquired from the successful organization of a problem-based learning session are transferable and this can prove beneficial to medical educators irrespective of the teaching that they plan to provide in future. **BJHM**

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KEY POINTS

- Problem-based learning moves away from a traditional lectured-based didactic approach to a more student-centred approach.
- Although problem-based learning has been widely adopted in both undergraduate and postgraduate medical education, its effectiveness is still debated.
- Medical educators need to be familiar both with problem-based learning (in order to act as a facilitator) and with small group teaching and learning in order to deliver problem-based learning sessions successfully.