



## The Influence of Student Learning Styles and Faculty Teaching Preferences on Medical School Approaches to Problem-Based Learning

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Medicine is replete with excellent opportunities to effectively apply problem-based learning (PBL). Indeed, the value of PBL closely follows the value of medical education in that both seek to equip students with the ability to solve problems and apply knowledge, skills and abilities far beyond those encountered within any specific learning experience. Of the numerous definitions of PBL, most have four common elements: (1) learning objectives are translated into a problem, (2) successful solutions require an explanation, with a possible diagnosis and treatment options, (3) students use small group discussions to analyse and understand the problem and potential solutions, and (4) questions or issues that are not answered within small group discussion form the basis for further learning outside the group.

Advantages of PBL include a focus on “real life” core information; the fostering of valuable transferable skills such as leadership, team work, communication and problem-solving; the encouragement of a deep rather than surface approach to learning; and making curriculum content relevant to applied medical problems. However, no single educational strategy is ideal for all educational situations, and the success of PBL within medical education is very much dependent on knowing when it is best to apply PBL. Disadvantages of PBL include a requirement for teaching faculty to facilitate, rather than directly impart knowledge; a scarcity of teaching faculty with this ability; the need to provide appropriate training in PBL; the time required for students and faculty to fully engage in PBL; knowledge acquired through PBL possibly being less organised than knowledge acquired through traditional learning; and potential time, cost and resource implications.

Key words: problem-based learning, learning styles, teaching preferences

### Background and Definition

By its very nature medicine is replete with excellent opportunities for the effective use of problem based learning (PBL). When appropriately applied PBL is an invaluable aid to teaching specific medical related educational objectives (or outcomes). However, whereas PBL is a valuable asset for those involved in instructional design, PBL is not the optimal method for teaching all medical sessions. Rather PBL is most suited to teach those objec-

tives best taught when learning commences as a problem, query or question that students need to solve<sup>1</sup>. PBL goes beyond merely providing an opportunity to solve problems and, instead, makes problem solving the main reason for learning. Herein lies the power of PBL because the student is required to solve specific problems while acquiring knowledge on how to solve similar problems<sup>2</sup>. In this regard the value of PBL parallels the value of medical education in that both seek to equip students with the ability to solve problems far beyond those encountered within a specific learning experience. Considering the variety and complexity of real problems that will be encountered by medical practitioners it may be argued that it is this ability which becomes of greatest benefit in professional life.

PBL arose out of educational initiatives in the 1960s that were primarily based on theoretical advances in behavioural psychology. Several researchers<sup>3-5</sup> successfully argued that students who commenced learning by focusing on problems before attempting to understand underlying principles, had equal or greater success than students using a traditional approach whereby underlying principles were pre-

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sented first and then applied to a specific problem. PBL was initially developed and applied within a medical education context at McMaster University in Canada by Howard Barrows<sup>6-8</sup> and has since grown in popularity to such an extent that most courses in western medical training incorporate at least some component of PBL.

Of the numerous definitions of PBL, most have four common elements:

1. Learning objectives are translated into a problem.
2. Successful solutions require an explanation, with a possible diagnosis and treatment options.
3. Students use small group discussions to analyse and understand the problem and potential solutions.
4. Questions or issues that are not answered within small group discussion form the basis for further learning outside the group.

Research has revealed that experts compare a novel scenario to a real scenario with which they are familiar<sup>9</sup>. When applied to reasoning within medicine it is known this ability occurs naturally within experts but needs to be learned by novices. A scenario is typically used to provide an example from which a student may extrapolate and apply in later experience. Such a scenario fosters valuable active learning and may be related to a clinical, scientific or community problem<sup>10</sup>. Thus PBL offers the opportunity to provide medical professionals with learning experiences that will be of use throughout their professional life<sup>2</sup>.

## Value of PBL

Numerous researchers argue for the benefits of PBL<sup>11-13</sup> and the popularity of PBL as well as its rapid widespread adoption by the medical community has arisen from several powerful advantages. These include<sup>14</sup>:

- Making curriculum content relevant by building learning around clinical, community or scientific problems.
- Focusing learning on core information relevant to real scenarios and reducing information overload.
- Fostering the development of valuable transferable skills useful throughout life-long learning. These include leadership, team work and communication as well as problem solving.
- Facilitating medical professionals to become responsible for their own learning. This is an essential skill for all professionals actively engaged in their own continuing development.
- Increased motivation of medical professionals to learn by focusing the learning on “real-life” scenarios.
- Encouraging a deep rather than surface approach to learning by forcing students to interact with information

on multiple levels and to a greater depth than traditional teaching approaches.

- Using a constructional approach to learning whereby students construct new learning around their existing understanding. Many of these advantages are particularly pertinent to medicine and should be optimally exploited by course designers.

## Potential Problems of PBL

Despite the significant advantages described above no single education strategy is perfect for all educational situations and PBL has several significant disadvantages. These include<sup>14</sup>:

- Teaching faculty being required to facilitate learning rather than to directly impart their knowledge. This may be considered inefficient and, possibly, demotivating to faculty.
- Knowledge acquired through PBL being less organised than knowledge acquired through traditional learning.
- The difficulty of training facilitators and the paucity of teaching faculty with the skills of facilitating rather than the skills of traditional teaching.
- The time required to fully engage in PBL. This can be particularly problematic for the typically crowded medical curriculum where time-poor faculty and students are asked to teach and learn under significant time pressures.
- The replacement of the traditional teacher role by the facilitator which may make it difficult for students using PBL to emulate good traditional teachers as role models. However, students will be better able to emulate good facilitators.
- Additional disadvantages include the significant costs, resources and time required to train effective facilitators. PBL experts also point to concerns about the costs of implementing PBL programs, though note that other researchers argue that PBL is not necessarily more expensive than traditional educational approaches<sup>15,16</sup> and raise the issue of PBL not necessarily covering all areas within medicine<sup>14</sup>.

When considering the use of PBL for all or part of a medically focused learning experience, course designers should be aware of the above potential problems and carefully consider how to minimise or eliminate any negative impact upon learning. Those involved in medical education who seek additional comprehensive reviews of research evidence for and against PBL are referred to excellent articles by Albanese and Mitchell<sup>17</sup>, Berkson<sup>18</sup> or Vernon and Blake<sup>19</sup>.

## Learning Preferences

In 1986 Honey and Mumford<sup>20</sup> published a manual of learning styles. They argued that each individual student has a preference for one of four learning styles; activist, reflector, theorist and pragmatist.

- **Activists** are characterised as learning by ‘doing’. They tend to be open minded, enthusiastic, get fully involved in new experiences, and are particularly curious about how things work.
- **Reflectors** are characterised as learning through reflecting. They prefer to stand back, listen and observe, collect and analyse information on their own, listen for and interpret meaning, may be slow to participate in new activities and are cautious, thoughtful and methodical.
- **Theorists** are characterized by seeking to understand. They integrate observations into known or new theories, enjoy analysing and synthesizing, value rationality, logic, perfection and may appear detached and analytical.
- **Pragmatists** are characterised as learning through implementation. They prefer to try out ideas, theories and techniques to see if they work in practice, search out new ideas and experiment with applications. Pragmatists are often impatient with activity that is not clearly relevant to their perceived task.

Table 1 summarises the characteristics of each of the four learning styles identified by Honey and Mumford. The table shows that students with each learning style have both preferred and non-preferred approaches to learning that result from their learning styles. Consideration of the information in Table 1 readily reveals that students with certain learning styles will be more conducive to learning using PBL than students with other learning styles. It is important to emphasise that there does not exist any qualitative difference between any of these preferences.

## Teaching Preference

Not only do students have their own preferred learning style, but faculty also have their own teaching preference. Teaching preferences may include the instructor, moulder, guide and coach:

- **Instructors** primarily teach by conveying knowledge, skills and abilities in a direct manner.
- **Moulders** work with the student to enhance their weaknesses and support their strengths. Moulders appreciate that the students in their care may be considered raw material which can be moulded.
- **Guides** approach teaching as a journey with a series of

Table 1 Learning and teaching experiences likely to have the greatest and least appeal for students with each learning preference (from Honey and Mumford 1987<sup>20</sup>)

| Learning Styles | Students most interested in:                                                                                                                                                                                                                 | Students less interested in:                                                                                                                                                                                                                    |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Activist        | <ul style="list-style-type: none"> <li>— New experiences &amp; activities</li> <li>— Exercises that emphasize involvement</li> <li>— Role play</li> <li>— Excitement, drama</li> <li>— Public demonstrations</li> </ul>                      | <ul style="list-style-type: none"> <li>— Lectures</li> <li>— Reading</li> <li>— Observing others</li> <li>— Analysing data</li> <li>— Being told what to do</li> <li>— Repeat opportunities to practice</li> </ul>                              |
| Reflector       | <ul style="list-style-type: none"> <li>— Observing others</li> <li>— Time to think things over</li> <li>— Discussion of ideas</li> <li>— Watching videos</li> <li>— Having time to prepare</li> <li>— Reading</li> </ul>                     | <ul style="list-style-type: none"> <li>— Public demonstrations</li> <li>— Exercises that get them involved</li> <li>— Role play</li> <li>— Having set time limits</li> <li>— Being told what to do</li> <li>— Pressurised situations</li> </ul> |
| Theorist        | <ul style="list-style-type: none"> <li>— Situations where they have to “think things through”</li> <li>— Complex situations</li> <li>— Models &amp; theories</li> <li>— Knowledge of purpose &amp; expectations</li> </ul>                   | <ul style="list-style-type: none"> <li>— Unstructured situations</li> <li>— Under directions or purpose</li> <li>— Highly emotional situations</li> <li>— Time pressures</li> <li>— Repeat opportunities to practice</li> </ul>                 |
| Pragmatist      | <ul style="list-style-type: none"> <li>— Practical &amp; relevant experiences &amp; activities</li> <li>— Action plans for their studies</li> <li>— Implementation of ideas</li> <li>— Role play</li> <li>— Learning from experts</li> </ul> | <ul style="list-style-type: none"> <li>— Irrelevant learning</li> <li>— Unfocused activity</li> <li>— Observing others</li> <li>— Analysing data</li> <li>— Being told what to do</li> </ul>                                                    |

end points. Guides offer direction to students along the journey and often choose to teach by example.

- **Coaches** appreciate that each student is unique and coaches are adept at tailoring their teaching strategy to meet the needs of each individual. Coaches also accept that the ‘educational personality’ of students changes over time and usually have a broad range of strategies to offer their students.

None of these preferred teaching styles should be considered to be better or worse than others. All are valuable, however, each is better suited to different types of instructional technique. Table 2 summarises the teaching approaches characterised by faculty with preferences for each of these teaching preferences. Consideration of these characterised approaches readily reveals that faculty with some teaching preferences are more suited to PBL than others.

Table 2 A summary of the teaching approaches characterised by faculty with one of each of four teaching preferences

| Instructor | Moulder     | Guide         | Coach      |
|------------|-------------|---------------|------------|
| Tell       | Develop     | Lead          | Cultivate  |
| Impart     | Mould       | Guide         | Encourage  |
| Transmit   | Produce     | Initiate      | Nurture    |
| Give       | Ask         | Help          | Develop    |
| Propound   | Reinforce   | Show          | Foster     |
| Convey     | Prepare     | Point-the-way | Enable     |
| Expound    | Direct      | Explore       | Bring out  |
| Transfer   | Demonstrate | Discuss       | Mentor     |
| Direct     | Push        | Share         | Plant      |
| Fill       | Motivate    | Participate   | Challenge  |
| Inform     | Inspire     | Offer         | Advise     |
| Instruct   | Shape       | Suggest       | Facilitate |
| Input      | Drive       | Negotiate     | Coach      |
| Drill      | Persuade    | Collaborate   | Grow       |
| Condition  | Sell        | Validate      | Counsel    |

Implications for Instruction

The variety of learning styles and teaching preferences explains why, in any medical school that adopts PBL as its only method of instruction, there may exist a wide degree of satisfaction amongst both students and faculty. Some students have learning styles that predispose them to be very positive towards PBL and for whom PBL will be the ideal mode of learning. Conversely some students have learning styles that predispose them to be very negative towards PBL and for whom PBL will be far less than the ideal mode of learning. Similarly other faculty have teaching preferences that predispose them to be very positive towards PBL and for whom PBL will be the ideal mode of teaching. Conversely other faculty have teaching preferences that predispose them to be very negative towards PBL and for whom PBL will become a significant challenge. These learning styles and teaching preferences can be mapped on continuums of learning and teaching. Such a map (see Fig. 1) illustrates the appeal and effectiveness that PBL is likely to exert for individual students and faculty.

Effect on PBL Based Medical Schools

In countries or regions where students and faculty have a large choice of the medical school in which they may choose to participate (such as North America and Australia) the learning styles of students and teaching preferences of faculty will gradually lead to a change in the student and faculty populations of PBL based medical schools. The reasons for this are that when choice of medical school is based purely on learning style, students whose learning

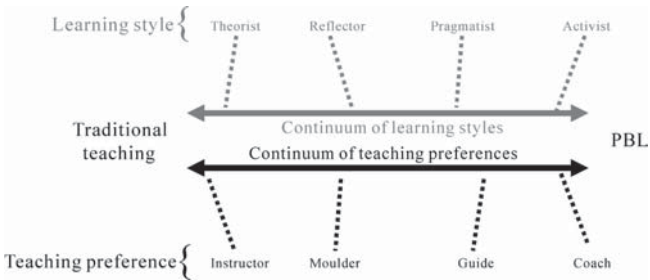


Fig. 1 Learning styles and teaching preferences placed upon continuums of teaching and learning.

preferences closely match PBL will be attracted to PBL based medical schools. Whereas students whose learning styles closely match more traditional learning will be attracting to more traditional medical schools. Within PBL based medical schools this rapidly creates a homogeneous student population whose learning styles are most suited to PBL. Similarly faculty, who are able to choose between large numbers of medical schools, will gravitate to the schools that best reflect their teaching preference. For example, faculty whose teaching preferences closely match PBL will actively seek to join a PBL based medical school. Conversely faculty whose teaching preferences do not closely match PBL will choose to teach in alternative medical schools. Initially, within a newly created PBL medical school, this may involve significant faculty turnover as faculty who prefer traditional approaches seek to leave the newly imposed PBL, and pro-PBL faculty who are based outside the PBL school actively apply to join the school. This rapidly crates a homogeneous faculty who are proponents of PBL and who have similar PBL orientated teaching styles. This effect is summarised in Figures 2a and 2b.

Naturally the homogenisation of medical school populations can only occur in those countries or regions where there is a large number of medical schools that offer a variety of learning/teaching methods, and where the primary motivation for choice of medical school for students is learning style, and where the primary motivation for choice of medical school for faculty is teaching preference. One of the pertinent outcomes is that typically students and faculty in homogenous populations that match a specific instructional approach (for example, either PBL or traditional teaching) will tend to experience and exhibit a uniformly higher level satisfaction. Conversely students and faculty within heterogeneous populations forced to adapt to a single educational approach will tend to experience and exhibit a lower level of satisfaction.

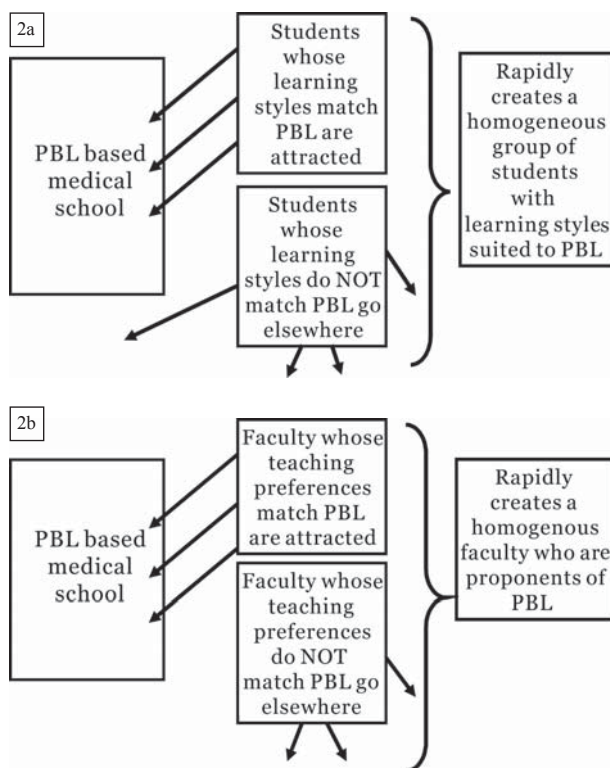


Fig. 2 (a) The tendency to create a student population with homogenous learning styles in PBL based medical schools. (b) The tendency to create a faculty population in PBL based medical schools with homogenous teaching preferences

## Optimal Approach

There are significant consequences for medical schools that are comparatively new to PBL and whose students and faculty have not had time to become homogenous with regard to PBL learning styles and teaching preferences. There exist similar significant consequences for medical schools whose students and faculty are not free to choose an alternative medical school if they do not have learning and teaching preferences predisposed towards PBL. Such a school that adopts a wholly PBL approach (or indeed a wholly traditional approach) will encounter a wide variety of support and enthusiasm from its heterogeneous students and faculty. Given that such a school has (1) students with a diverse range of learning preferences, (2) faculty with a diverse range of teaching styles, and (3) a broad range of course content, an optimal approach would be for the school to consider using multiple methods for teaching. Each method of teaching/learning should be specifically matched to the specific curriculum content to be taught and



Fig. 3 Examples of medical knowledge, skills and abilities that might be most effectively taught, within a heterogeneous medical school, by a combination of traditional and PBL approaches.

learned. For example, consider the list of knowledge, skills and abilities in Fig. 3. All are essential for doctors, yet it is likely to be more efficient to teach knowledge of terminology, facts, principles and techniques via traditional teaching methods. Similarly it is likely to be more efficient to teach application of knowledge, development of novel ideas, attitudes, leadership, communication and teamwork abilities via PBL. Such an approach will have the advantage of catering to the preferred learning styles and teaching preferences of a diverse range of students and faculty whilst also optimising the efficiency by which these essential components of medical school curricula can be taught and learned.

## Developing PBL Scenarios

A scenario is typically used to provide an example from which a student may learn. Such a scenario may be related to a clinical, scientific or community problem<sup>10</sup>. Part of the rationale for this approach arose from a contrast of the medical reasoning skills of novices and experts. Research revealed experts compare a novel scenario to past scenarios with which they are familiar<sup>9</sup>. Much of an expert's diagnostic and reasoning efforts are focused on the similarities and differences of a novel case with known cases. Therefore it is reasoned that an efficient method of educating a novice is to provide them with seminal experiences that will allow them to develop a memory of a broad range of known cases, that is, will aid novices to think like experts. In this regard the choice of PBL scenario is pivotal for the focus and ultimate effectiveness of the learning experience.

The enormous range of educational resources available in medicine as well as the considerable clinical experience of faculty means that the number of potential scenarios approaches the infinite and is limited only by the imagination of those involved in scenario development. This highlights the value of using a team to develop scenarios. A team of developers will allow a variety of different perspectives to be brought to focus on the scenario. Ideally this should be a multidisciplinary team as the combined efforts of such a group will ensure that scenarios are optimally robust. The simulation course designer should seek to use a PBL scenario as either a “peg” or “growing web”<sup>21</sup>. The peg may be viewed as a convenient hook upon which to arrange acquired knowledge whereas the growing web uses the problem as a focus for acquired practical understanding. Carefully structured problems ensure students comprehensively cover appropriate knowledge, skills and abilities relevant to the desired educational objectives. Ideally a course designer should use a PBL approach if the problem scenario exhibits several characteristics<sup>22</sup>. The problem should:

1. Address one or more learning outcomes relevant to the medical students.
2. Facilitate students to raise their prior learning and experience to conscious consideration and to build upon existing knowledge.
3. Be consistent with the stage of learning at which the students are located.
4. Motivate students and, ideally, be related to the current or future medical practice of these students.
5. Provide an overall clinical context in which new knowledge is placed.
6. Stimulate thought and discussion, provide guidance and encourage students to actively seek solutions.
7. Phrase an open ended problem to facilitate discussion and explanation (i.e., closed problems with limited scope should be avoided).

Wherever possible PBL scenarios should be based on real patients, or composites of real patients, in order to ensure students appreciate that they may encounter the same or similar problems in practice. Fortunately such scenarios are reasonably easy to create. Furthermore, the use of actual patients allows the designers of PBL scenarios to incorporate de-identified laboratory results, x-rays, scans and pathological materials<sup>23</sup>. When choosing a scenario, designers should consider what topic area experts believe should be taught relevant to the intended learning objectives as well as the prevalence, severity, magnitude, treatability and intervention effectiveness<sup>23,24</sup>. Once a scenario has been developed it should be piloted

with an audience of students representative of the intended learners for whom the scenario was developed.

## Facilitating PBL

Beyond the PBL scenario the single greatest factor that influences the success of a PBL program is the facilitatory skill, knowledge and ability of faculty. Such is the importance of facilitation that, within PBL, the teacher is usually referred to as the “facilitator”. Adequate facilitator training and experience is essential for any PBL session to function optimally<sup>2,23,25,26</sup>. PBL is a non-traditional approach that differs significantly from traditional teaching. Of the pool of potential instructors available to any medical school it is likely that few will be familiar with a true PBL approach and even fewer will be able to facilitate PBL sessions without additional training and experience. If PBL is used then it is essential that those faculty who will undertake the facilitation of PBL sessions receive adequate and appropriate training in facilitation.

In true PBL the facilitator does not direct learning, dominate conversation or provide direct answers to questions (unless this is necessary for the preservation and progress of the scenario). Instead the facilitator becomes a learning guide who assists students develop their own reasoning and hypothesising whilst concomitantly allowing students to evaluate these hypotheses and assess their own knowledge, skills and abilities<sup>2,6</sup>. The facilitator achieves this by continually monitoring and stimulating the PBL process and interpersonal dynamics of the group. Tools for the facilitator are the phrasing of open questions, guiding feedback, managing group dynamics, challenging student knowledge and understanding, and raising pertinent facts or issues in a timely manner.

Facilitator competence must include<sup>14</sup> the facilitation of small group learning; a comprehensive understanding of the PBL program such that the facilitator can relate immediate and future learning opportunities to the PBL scenario and guide students to these opportunities; and a global understanding of the overall educational curriculum so that the facilitator can place discrete problems within the global educational experiences of the students. The abilities of facilitators to establish effective two-way communication with students, empathy and an open and trusting atmosphere have also been shown to be important<sup>27</sup>. Effective use of PBL will best occur if instructors who are not experienced in any of the above are provided with the necessary instruction and experience prior to their involvement as a PBL facilitator. Once this experience has been gained each facilitator should be fully briefed about the

problem and related learning<sup>28</sup> as well as the relationship of the problem and intended learning to the scenario.

Research has shown that content area experts may endanger PBL by exerting too great a director role and reducing the effectiveness of collaborative learning<sup>29</sup> as well as directly answering students questions, devoting greater amounts of time to the development of learning issues than students devote to solving them, and by talking “too often and too long”<sup>30</sup>. However, it is likely that a content area expert, who has been correctly taught in the procedures and nature of PBL, should be able to successfully facilitate a PBL session whilst resisting reverting to a traditional mode of teaching. Such a facilitator would be ideally placed to be able to limit the extent to which they provide solutions to students, consistent with a PBL approach, yet able to provide the minimal level of clinical structure necessary for students to obtain optimal benefit from PBL<sup>31,32</sup>. However, whereas the extent to which a facilitator is required to be a content expert is a matter of some debate within the literature, all PBL specialists agree that adequate training in the role of facilitator is essential for the success of a problem-based learning program. Those designers of medical courses who are interested in developing the PBL skills and abilities of their instructors are referred to excellent references by Barrows<sup>25</sup> and Irby<sup>33</sup>.

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