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A preliminary exploration of the efficacy of self-directed learning in a new PBL medical course

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Abstract: The medical course at the University of Notre Dame Australia (UNDA) uses a problem-based learning (PBL) curriculum adapted from one developed at The University of Queensland. The aim is for self-directed student learning using clinical problems to identify what to learn. The result is the generation of a set of learning objectives each week. This study is a preliminary attempt to gauge the efficacy of self-directed aspects of the PBL model at UNDA by comparing the weekly learning objectives that students generated (SLOs) with the learning objectives that the teachers, who developed the curriculum, expected them to derive (TLOs). SLOs were collected from PBL groups during the first eight weeks of the second semester, 2005. TLOs for each case were compared with the SLOs of the PBL groups: any matches were identified (MSLOs). Additional learning objectives, on the students' list but not found on the TLOs list, were also compiled (ASLOs). Analysis showed that the average of MSLOs was 46 % of the TLOs but the ASLOs represented 43 % of the overall SLOs. Students are often conservative in their learning objectives, so the MSLOs may not be those that students used solely to guide their learning. The results suggest that there is a need for further curricular review at UNDA to promote a better match between students' and teachers' expectations of what should be learnt in the first year of a PBL medical course.

Keywords: PBL, Self-directed learning, Student generated learning objectives, Curriculum Implementation.

Introduction

The PBL model developed by Burrows and Tamblyn (1980) has received both plaudits and intense criticism (Miflin, 2004a). Advantages and difficulties of student self-directed learning, using a PBL model, were reviewed by Walker and Lofton (2003). These authors emphasised that the manner of introduction of the PBL course, and the students' prior experience of self-directed learning, contributed to successful curriculum implementation. The value of a well founded orientation program to a PBL approach, involving both faculty as well as the students, was reported by Miflin, Campbell, and Price (1999) and their recommendations have been incorporated into the PBL model in use at UNDA. Notably these investigators emphasised that regular briefings and debriefings, and formative evaluations for both students and tutors, were necessary. Ignoring these key factors in the design of a PBL curriculum, particularly in medical courses, may lead to criticism of the effectiveness of the PBL model (Neville, 1999). One method of assessing the efficacy of PBL is measuring the level of engagement of the students during periods of self-directed learning. Ahlfeldt, Mehta, and Sellnow (2005), using a student engagement survey, reported that a well-constructed PBL

curriculum encourages a higher level of student engagement than other methods of self-directed learning. Miflin, Campbell, and Price (1999) assessed the efficiency of an earlier PBL trial by estimating levels of student learning anxiety. These investigators concluded that anxiety rates were high if the PBL model did not provide adequate guidance of the depths to which the students were required to study.

The graduate entry Bachelor of Medicine/Bachelor of Surgery degree (MBBS) course commenced at UNDA in February 2005. There are three prerequisites for admission: completion of a Bachelors degree within the last 10 years with a Grade Point Average of 5; satisfactory performance in the Graduate Australian Medical Schools Admission Test (GAMSAT); and satisfactory performance in an Admissions Interview. The four-year MBBS course benefits from an innovative collaboration with Curtin University of Technology. Staff from Curtin's School of Biomedical Sciences provides the teaching of the basic biomedical science components of the clinical problems that are studied during the first two years of the MBBS course. The final two years involve supervised clinical sessions at private and public hospitals, and private medical practices.

The curriculum model for the first two years of the MBBS course is problem-based learning (PBL). Each week, by analysing a patient's problem, students identify deficiencies in their knowledge that prevent them from fully understanding the biomedical science underpinning the problem. These knowledge deficiencies, identified by the students, become their learning tasks and are referred to as Student Learning Objectives (SLOs). Learning resources help students to address their SLOs, and these include lectures, practical classes and clinical skills sessions. Students work in groups of eight under the guidance of a PBL tutor. The aim each week is for students to develop effective clinical reasoning skills. This is achieved by working through the problem using an hypothetico-deductive model so that students learn over time to base clinical decisions on sound evidence synthesised from the patient, from their understanding of the science underlying clinical presentations, and from their knowledge of patients as members of communities. In their first year, success in working through the weekly problems requires an understanding of the basic science and relevant clinically related skills. The curriculum uses carefully selected case studies that enable the students to solve relatively easy cases during the early stages of the first semester, proceeding to more complex cases requiring application of knowledge gained from earlier cases to reach a solution. Time was also programmed into each week for debriefing and review of the clinical aspects of the cases currently under study.

The MBBS graduate entry course at UNDA implies that students bring a level of maturity and prior knowledge often absent in undergraduates, although some criticism of this assumption has been reviewed by Miflin (2004b). The selection process into the MBBS degree program ensures a high level of general knowledge and communication skills. However, few of the graduates would have previously experienced a total immersion PBL curriculum, so it is possible that highly motivated achievers may resist a departure from a personal learning system that has served them well in the past. During the first few weeks of a curriculum based on PBL the level of anxiety amongst students usually is raised, particularly when the time of the first formative assessment approaches (Walker and Lofton, 2003; Miflin, personal communication, 2005). A reason suggested for student anxiety is that each week they are required to formulate their own learning objectives rather than be given learning objectives by the teachers who developed the course. The study reported in this paper seeks to contribute to further understanding of this process of self-directed learning in a PBL curriculum by

collecting a sample of learning objectives compiled by the students (SLOs), comparing them with those supplied by the teachers (TLOs), and examining the degree of congruency.

Background to the study

The 2005 student cohort was divided into ten PBL groups, (eight in each group), each moderated by an experienced PBL tutor who facilitated the group throughout the semester. Students were allocated to a PBL group to ensure a careful mix of genders, ages and backgrounds as far as possible.

Each weekly case started with a two-hour session on a Friday morning. The cases were delivered from an online source via a networked computer in each PBL room. The cases started with a series of triggers that assumed that the students were either role-playing a doctor in general practice, or in a hospital emergency department, presented with a new case. Each trigger sequentially presented a brief account of a patient's medical details ranging from the patient's history, and initial examination to more advanced diagnostic procedures. Sometimes, additional information was presented in the form of images or videos. After each trigger the students engaged in a brainstorming session making numerous relevant suggestions. Each week a student in each group summarised, on a whiteboard, all the results of the brainstorming session: the SLOs were generated from this list of topics. The next two-hour PBL session was on the following Wednesday when the case study continued and students added to their list of SLOs. Typically, in each case, the sequence of triggers gradually unfolded from the initial presentation, history, examination, provisional diagnosis, and treatment to the final outcome. Before students moved on from each trigger it was the responsibility of the PBL tutor to make sure that the students considered as many implications of each trigger as possible. The most important outcome of each brainstorming session was a list of hypotheses related to the progress of the problem. The patient's problem unfolded with each trigger and the students constantly re-evaluated their hypotheses. The case study was finally completed in a one hour session on the following Friday: this session also included a quiz, which emphasised the underpinning knowledge related to the current case, based on the biomedical studies carried out at Curtin University.

At the end of each weekly PBL session each group completed a general evaluation, which was designed to monitor the progress of the PBL component of the MBBS course. One section of this evaluation asked students if they had been able to identify appropriate learning objectives.

Material and methods

The first eight week's problems featuring in the second semester were selected for the present study to allow one semester for students and tutors to adjust to the PBL system. At the end of the week each scribe copied the list of learning objectives compiled by the PBL group (SLOs) onto a dated recording sheet carrying the PBL group number. These sheets were collected by the PBL tutor and collated with other PBL groups. They were then filed together with details of the case and full details of the learning objectives determined by the course development teachers (TLOs), which had been made available to the students at the end of each study week.

Figure 1 illustrates the data sources for this study. Student learning objectives (SLOs) were classified as MSLOs if they were congruent with TLOs, and ASLOs if they were not

congruent. TLOs not matched by SLOs were categorised as Extra Teacher Learning Objectives (XTLOs). An Excel spreadsheet was used to list the SLOs of each PBL group for each of the eight study weeks and compare them to the list of TLOs. Matching learning objectives were coded and entered as MSLOs on the spreadsheet. When all the SLOs on the data sheet were examined any additional learning objectives that were on the students' list, but not represented on the TLOs list, were coded as ASLOs. The data from all the PBL groups were pooled to give for each week the total MSLOs and ASLOs. This process was repeated for each of the eight weeks of case studies.

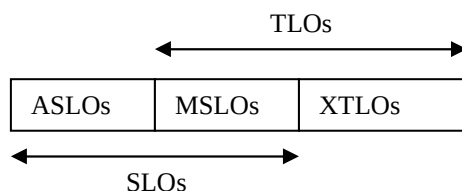


Figure 1: Diagram illustrating data sources used in this study

The data was further converted into percentages to obtain pooled data that could be readily summarised. The total SLOs were separated into MSLOs and ASLOs, expressed as proportional percentages for illustrative purposes. Those TLOs not listed by any PBL groups were coded XTLOs and the analysis was restricted to pooled data from the eight study weeks. Data from the end of week evaluation used a rating scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to rank student impressions of how closely they believed their SLOs were appropriate to the case. An average of the rankings was taken across the ten PBL groups for each study week throughout the year. The present study took a mean of the average rankings from week 26 to week 34. For comparison, a mean was taken of the rankings from the first eight weeks of the first semester, when it might be presumed that students were not confident of their ability to select appropriate SLOs.

Results

Table 1: Summary of analysis of all MSLOs from weekly returns covering the eight case studies. MSLOs are expressed as totals in column two and as % of TLOs in column three

Study Week	Total MSLOs	% of TLOs
Week 26	42	52
Week 27	26	29
Week 28	20	50
Week 29	27	45
Week 30	25	36
Week 31	38	63
Week 32	31	39
Week 34	24	50
Mean	29	23

Table 1 shows that over the eight study weeks the average number of MSLOs was 29 (range of 20-42). The overall mean percentage of MSLOs, compared to the TLOs, was 46 % (range 29 – 63 %).

When the SLOs were separated into percentages of MSLOs and ASLOs, 43 % of the total pool of SLOs was ASLOs and the remaining 57 % were MSLOs. Comparison between these

two categories is illustrated in Figure 2, which expresses them as proportional percentages of the total SLOs in each study week.

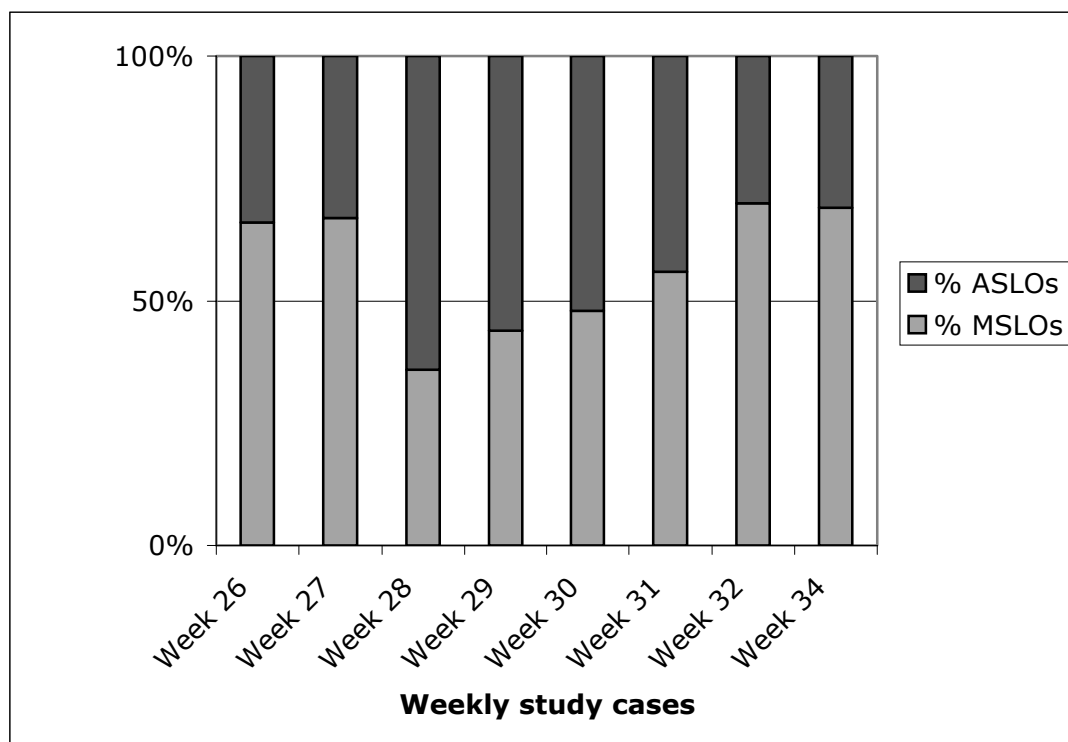


Figure 2: Weekly PBL group averaged percentages of MSLOs and ASLOs compared in a percentage stacked column format

An analysis of the results of the data coded as XTLOs showed that over the eight weeks only twelve out of a total of 62 TLOs (19 %) were scored as XTLOs. That is, 19 % of TLOs were not included by any PBL groups with their SLOs.

The results of the PBL group evaluations, that asked students if they thought their SLOs were appropriate in each study week, revealed that over the eight study weeks the students from all groups averaged a rating score of 3.7 (1 = strongly disagree). However, when a similar analysis was carried out for eight weeks at the start of their PBL studies in semester one, the average score was 3.8.

Discussion

There are many interpretations of the aims of learning objectives determined by course developers. In this study, the authors made the assumption that the TLOs represented the main outcome of each case study. The PBL model is designed so that, ideally, each PBL group generates a set of learning objectives that closely match the TLOs. The results showed that over the eight weeks of this study an average of 46 % of the TLOs were selected by the students. Averages conceal the real data but Table 1 shows that the highest match occurred in week 31 with MSLOs of 63 % with three other weeks returning matches around 50 %: conversely the lowest match was in week 27 with MSLOs of 29 %. Whether or not the match of SLOs to the TLOs satisfied the students or caused anxiety is difficult to estimate, although the weekly PBL evaluation indicated that the students agreed (a ranking of 3.7) that the problem allowed them to identify appropriate learning objectives. However, it is not known if,

at the time of the evaluations, all students had read the TLOs which are only available online at the end of each study week.

TLOs provided for week 26	Total number of MSLOs
Anatomy of the heart	5
Embryology of the heart	8
Mechanisms of gas exchange	3
Microbiology & Immunology	9
Hypotheses of disease causation	2
Ethical issues of immunisation	2
Examining the cardiovascular system	4
Cyanosis	7
Congenital cardiac problems	2

Table 2: List of TLOs and the number of PBL groups which matched those TLOs in week 26
(the PBL case was a congenital heart defect in a child)

Table 2 lists examples of the TLOs given for week 26 and the corresponding number of PBL groups whose SLOs matched those TLOs: overall, 52 % of the TLOs were matched. However, all TLOs were matched by at least two PBL groups, so there were no XTLOs for this problem. It is of interest that the more commonly chosen MSLOs dealt with basic clinical science. MSLOs less frequently chosen dealt with ethics or public health issues. Similar trends occurred in the MSLOs from other weeks. Students may have considered such issues less relevant to the problem and so focused on aspects of basic clinical science. The present study did not ascertain whether or not individual student's study was guided solely by the SLOs.

Over the eight weeks, 43 % of the total SLOs were unmatched so were categorised as ASLOs. These ASLOs mainly related to complex clinical aspects, differential diagnosis and treatment. In week 26, for example, a list of nine different ASLOs was generated (34 % of the total SLOs of that week). Three examples from this list, chosen by three PBL groups, were:

- Treatment of the congenital condition Tetralogy of Fallot;
- Blalock-Taussig shunts, and
- Developmental milestones in a child.

Most of the ASLOs would have required in-depth study of more complex functional anatomy or biochemistry related to the problem; this detail was not the aim of first year PBL learning and so was not part of the TLOs although will be required at later stages in the course.

The preliminary analysis of the pooled XTLOs showed that only 19 % of TLOs were scored as XTLOs. In most cases the XTLOs related to social, ethical and epidemiological aspects of the case studies. This finding is consistent with the discussion above in relation to MSLOs chosen by fewer groups as shown in Table 2.

In conclusion, it would appear that students engaging in a PBL system of learning need regular reassurance that whether they list most of the TLOs during their study weeks or rely on finding them out at the end of each week is not really a serious issue. The present preliminary study suggests that nearly half of the TLOs will be identified on most occasions. However, most of these MSLOs are consistent with the aims of this PBL curriculum model

that focuses on the acquisition of knowledge of the basic clinical sciences during the first year of the MBBS degree. The present study found no evidence to suggest that the mismatch between SLOs and TLOs is linked to student learning anxiety: these issues should be explored using qualitative methods. Further investigation may assist in understanding why some of the TLOs were not listed and some further modification to this PBL model may be able to obviate this deficit. The value of the PBL model used at UNDA is that student engagement in working through the case studies has proven to be high which enables the development of good reasoning skills, identification of the most relevant learning objectives, and appreciation of the need for collaboration and development of communication and social skills.

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