Acquiring professional skills through a problem-based learning course in a subject-based curriculum

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Abstract

Background: Professional skills, including team-work, self-directed learning and accountability are applicable to a range of clinical scenarios and contexts. Theoretically, these skills can be acquired by a course of learning within a problem-based learning (PBL) paradigm. The aim of the study was to evaluate student perceptions of learning achievement and student acceptance of a PBL unit of study (course) in paediatric physiotherapy that was embedded within an established subject-based physiotherapy curriculum.

Method: The study had two phases and involved two student cohorts, with some revisions to the second cohort's learning program and the questionnaire based on findings from the first cohort investigation. In Phase 1 (cohort 1), 154 (82 per cent) of the students completed questionnaires evaluating the learning program. Focus groups were conducted ten months later with 18 students. In Phase 2 (cohort 2), 118 (62 percent) of the students completed a revised questionnaire. For Phase 1, mean rating agreement for meeting all learning outcomes was between 84 per cent and 97 per cent. Most suggestions from the questionnaires and focus groups concerned unit structure and process.

Results: For Phase 2, mean rating agreement for meeting all learning objectives was between 88 per cent and 96 per cent. Students' perceptions that they had attained pre-determined learning outcomes were consistent with their final marks and performance in the final oral examination.

Conclusion: Students can achieve learning outcomes from an embedded PBL unit of study and derive benefits such as confidence in applying knowledge to novel situations.

Keywords: beginning practitioner, competence, problem-solving, paediatric physiotherapy

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Introduction

Problem-based learning (PBL) has been proposed as a desirable educational methodology for health professionals (Boud & Feletti 1997). Indeed, many of its elements or key features, such as self-directed learning and problem solving are congruent with the professional competencies expected of beginning practitioners. Among the requirements for graduates of tertiary programs is 'underlying skill and knowledge to enable competency to be demonstrated in new and unexpected situations' (The National Training Board 1992: 8), enabling them to be adaptable and to operate in a skilled manner. To cope with change and with increasing workplace demands, new graduates need to be able to deal effectively with an increasing body of scientific, technical and professional knowledge. Specifically, graduates need analytical and problem solving skills, and the capacity to continue to learn and develop as the workplace context changes (Bowden & Masters 1993).

Problem-based learning has been endorsed for medical students (Gwee & Tan 2001) and for physiotherapy students (Saarinen-Rahiika & Binkley 1998, Solomon 1994) to facilitate the development of important professional skills including problem solving, clinical reasoning and self-directed learning (Barrows 1994, Saarinen-Rahiika & Binkley 1998, Solomon 1994, Trevena & Clarke 2002). However, PBL has met with mixed levels of success in its effectiveness and acceptance by students and in its integration within allied health curricula (Bruhn 1992). Furthermore, the specific cost benefit of PBL in physiotherapy education

has been questioned by some (Morris 2003). Thus, while PBL may be a desirable approach, there is insufficient evidence in support of its adoption. This paper reports on an evaluation by physiotherapy students of an embedded, compulsory PBL unit of study in paediatric physiotherapy.

The need for change

Evidence for the merit of testing a new educational approach arose from mismatches between community expectations and graduate competencies identified from a previous multidisciplinary study of the Faculty of Health Sciences (Adamson *et al* 1996). In that study, 72 per cent of the surveyed employers believed that recent graduates possessed an adequate knowledge in their field of study and the capacity and desire to continue to learn; however, 48 per cent of them believed that graduates lacked the ability to apply theory to practice in unfamiliar situations, to exercise critical judgement and to apply rigorous and independent judgement or thinking. Recent graduates in the same study had positive perspectives on their skills and attributes for research activities such as designing a research proposal, writing a research report, and reading and evaluating professional literature (Adamson *et al* 1996). However, they considered themselves to be limited in their ability to utilise unfamiliar procedures in patient evaluation and treatment. The recommendations of the study included changes in the processes of students' learning (Adamson *et al* 1996).

A subsequent revision of the undergraduate physiotherapy curriculum provided the opportunity

for change. During the curriculum review process, all of the implications and recommendations of the study of Adamson *et al* (1996) were considered. Also, as part of the process, invited submissions were sought from practicing health professionals. Specific concerns of physiotherapists in paediatric settings were that recent graduates and students had difficulty incorporating the underpinning sciences into effective reasoning in the paediatric clinical context. In the revised curriculum, a discrete PBL unit of study (course) was developed that focused on paediatric physiotherapy. It replaced the former strategy of learning whereby paediatric physiotherapy content was presented within body system units of study, such as the musculoskeletal physiotherapy. Learning objectives (outcomes) addressed requisite professional competencies in paediatric physiotherapy. These included the assessment and management of children from birth to 18 years of age with a broad range of problems resulting from congenital or acquired conditions, in a range of health care settings within metropolitan or rural and remote environments. A PBL approach allowed the use of comprehensive patient scenarios to expose students to contextual aspects of management such as cultural influences and the availability of community resources.

A PBL approach offered many perceived advantages over other learning paradigms for this new unit of study. A critical educational goal for the current health context is that students accept the lack of certainty in the workplace and the need for ongoing learning (Higgs & Hunt 1999). In PBL, the educator sets tasks that have no definitive answers, or

that have a number of possible solutions. Learning also focuses on learning process as well as knowledge generation, thus promoting integrated learning and thinking skills (Bottorff 1986). This is 'action learning', in which experiential learning, creative problem solving, organisation of relevant knowledge and co-learning group support combine in the development of an individual's learning abilities as well as providing the opportunity for acquiring knowledge (Cusins 1995, cited in Johnson 2000). Self-determined learning is an important ability in a learning society that challenges and advances existing 'mindsets' (Rawson 2000: 236). In the paediatrics unit of study, these learning approaches were fostered by requiring discussions on the differing perspectives of evidence, and by allowing students in groups to determine the scope of their learning while directing them towards achieving the final learning goals. The goals of these group processes were therefore also consistent with the needs of graduates to be equipped with the necessary skills of being flexible, team-oriented, responsible, and creative in applying learning to new situations (Higgs & Hunt 1999).

Designing and evaluating an embedded PBL unit of study

The aim of this study was to evaluate the students' perceptions of their achievement of defined objectives and of the learning strategies used. A secondary aim was to explore the merit and student acceptance of a discrete PBL unit of study embedded within a subject-based and traditional educational framework.

The paediatrics unit of study was conducted over two (13 week) academic

semesters, with weekly tutorials (see Figure 1). There were ten tutorial groups each with approximately 20 students. Each tutorial group was divided evenly into two working subgroups. There were five tutors (facilitators), who were also involved in other units of study that utilised educational methods other than PBL. A characteristic of PBL is that it does not require tutors who are clinical experts (Dolmans *et al* 1996), but rather tutors who possess the ability to communicate with students in an informal way, and have an empathic attitude that encourages an open exchange of ideas and student learning (Schmidt & Moust 1995). Whilst content knowledge of the tutor may be pertinent in determining learner outcomes, such knowledge can be acquired by tutor training (Eagle *et al* 1992). Only three of the five tutors in the paediatrics unit had clinical experience in the field. Tutor training in PBL was therefore undertaken with input from external consultant educators. Comprehensive tutor notes were prepared and discussed at weekly meetings to ensure quality and equity in student learning.

Six paediatric scenarios were used. Their structure reflected typical presentations in clinical practice, from initial contact to ongoing management within a set timeframe of care. They covered key ages of childhood and commonly encountered situations. For each scenario, defined weekly tasks ensured that by the conclusion of that module, students had met specified learning outcomes. Emphasis was placed on clinical reasoning and an evidence-based approach
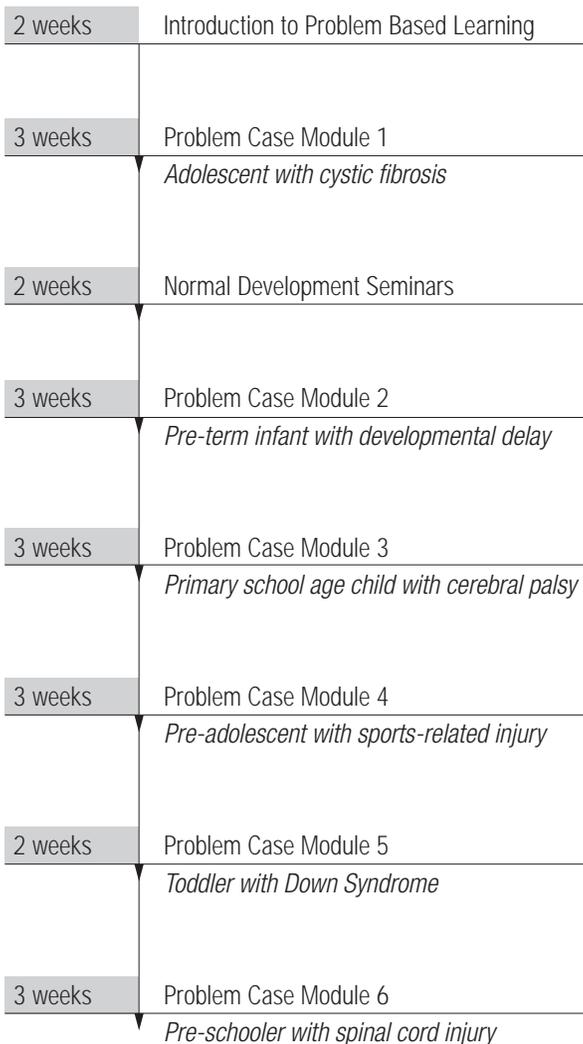
2 weeks	Introduction to Problem Based Learning
3 weeks	Problem Case Module 1
	Adolescent with cystic fibrosis
2 weeks	Normal Development Seminars
3 weeks	Problem Case Module 2
	Pre-term infant with developmental delay
3 weeks	Problem Case Module 3
	Primary school age child with cerebral palsy
3 weeks	Problem Case Module 4
	Pre-adolescent with sports-related injury
2 weeks	Problem Case Module 5
	Toddler with Down Syndrome
3 weeks	Problem Case Module 6
	Pre-schooler with spinal cord injury

Figure 1: Overview of the schedule for the Paediatrics unit of study

in the utilisation of human resources, for example experienced therapists and children/families. Support resources included access to relevant refereed journals, text materials, websites and online lectures. Published materials were provided for use in the tutorial sessions. Further published materials and web-based resources were accessed at the discretion of the learner(s), however, there was an explicit expectation that they would do so. There was one support lecture per case module; this was a two-thirds reduction in the number of lectures from the previous curriculum. The website provided the facility for asynchronous discussion between student and student/s and tutor.

Student assessment in this unit was designed to complement the learning goals, because it is influential in directing what and how students learn (Newble & Jaeger 1983, Taylor 1996). The first of three assessments occurred early in the academic year (Figure 1) with each student participating in a small group (n=3) student-led seminar on the topic of normal development. According to Rawson (2000), it is important to learn how to do things better, not just to learn how to do better things. To facilitate learner development in this unit of study, emphasis was placed on the reflection of reasoning as well as on the acquisition of learning skills and knowledge. At the end of each case module, students also completed a self-evaluation of their clinical reasoning ability, such as being able to identify key information, summarise initial hypotheses and determine effective strategies to meet their learning needs. At the end of the academic year, each student undertook an oral examination of their abilities in reasoning and self-directed learning, with two assessors. The examination was based on one of three new case scenarios that students had prepared for in advance.

Methods

This study was conducted as an evaluation of student perceptions in two phases. The Phase I evaluation was obtained from the first student cohort and Phase 2 was obtained from the second student cohort following implementation of a number of suggested changes. In both phases, opinions were sought from students about their success in meeting the stated learning outcomes and the value of their learning experiences. Ethical approval for the study was granted by The University of Sydney Human Ethics Committee.

Phase 1

This phase was an evaluation of the inaugural unit of study. It comprised a questionnaire distributed at the conclusion of the teaching (Appendix 1) and focus groups.

The questionnaire was designed to determine student ratings of statements pertaining to: meeting the unit of study learning objectives (ten items); the value of the specific learning experiences (11 items); the helpfulness to learning of the unit website (ten items); and the merit of the assessments (six items). In addition, the student could make suggestions for improvement to their learning.

Ten months later, two focus groups were conducted with 18 students, on the same day, in an interview room at the University. The timing of each one-hour focus group was intentional,

so that the students might have gained insight into the merit of the PBL unit in their subsequent practicum. Focus group members were stratified to be representative of the entire student cohort, that is according to gender, tutorial group and type of clinical experience. The groups were led by an external consultant educator who posed nine stimulus questions prepared by the researchers. These questions included: 'how did the Paediatrics unit help you to develop clinical reasoning skills?' and 'how did the processes of peer and self assessment support your perceptions of appropriate assessment?'. Each group was asked the same questions, in the same order. The results were transcribed from tape recordings and written notes by the external consultant from the learning support service of the University. The written report documented the processes that were followed and summarised the responses according to key student perspectives.

Phase 2

This phase consisted of a questionnaire, which was modified from that used in Phase I. It contained the same items pertaining to meeting the learning objectives (ten items). However, the 11 items pertaining to the value of the students' learning activities reflected modifications that had been made to the unit as a result of the Phase 1 questionnaire (Table 3). Similarly, the number of items relating to the website was reduced from ten to seven. There were 28 questionnaire items in total. The requirement of the open-ended comments was changed from that in Phase 1, such that students were asked to identify the three most helpful learning

processes in addition to being asked to provide other comments and suggestions for improvement in the unit of study.

Results

Phase 1 and Phase 2 results are presented separately. The data for the questionnaire items pertaining to meeting the learning objectives are displayed for both phases in Table 1. All questionnaire data are presented as percentage responses, to enable comparison across items and also between the two cohorts.

Phase 1

A total of 154 students (82 per cent of the enrolled students) completed the questionnaire. Mean total agreement (agree and strongly agree) across all items pertaining to meeting the learning objectives was 91.4 per cent (Table 1). For the items pertaining to the learning experience (Table 2), total agreement was 79 per cent or above, except for role-plays (at 41 percent). Most of the items were rated above 80 per cent. For the six items relating to the helpfulness in learning of the website, the mean total agreement was 67.5 per cent. The highest total agreement was at 88 per cent for both the library information and the unit of study outline. The lowest total agreement was that of 34 per cent for the discussion forum.

Most of the suggestions for improvement concerned the structure and processes of the unit and were consistent with the information derived from the focus groups. Few suggestions were directed to the topic of physiotherapy professional preparation. All student suggestions formed the basis for the curriculum changes made for the subsequent student

Table 1: Responses to questionnaire items pertaining to Meeting the Learning Objectives (outcomes): Phase 1 and Phase 2 (Cohorts 1 and 2).

The value for each response is presented as a percentage of the number of respondents for each item. For Cohort 1, there were 154 respondents; there were no missing data. For Cohort 2, there were 117 respondents; there was 1 missing data point for 9 of the items. Total Agreement is the sum of the values for Agree and Strongly Agree.

Consistent with the learning objectives, on completion of this unit of study I am now able to:	Strongly Disagree		Disagree		Agree		Strongly Agree		Total Agreement	
Cohort	1	2	1	2	1	2	1	2	1	2
Solve complex clinical problems accessing appropriate resources and using a process of clinical reasoning.	0	0	10	4	83	81	7	15	90	96
Demonstrate an understanding of normal growth and development from conception to maturity	0	0	16	10	77	70	7	20	84	90
Discuss the occurrence of variations in normal development and possible reasons for these.	0	0	12	11	84	79	4	10	88	89
Differentiate between normal and abnormal growth, development and function.	0	0	7	8	82	80	11	12	92	92
Recognise the potential impact of abnormal development on the skeletal, respiratory and neurological systems	0	0	9	10	79	81	12	9	92	90
Recognise the potential psychological impact of illness, disease and/ or disability on a child's family/community.	0	0	3	10	74	73	23	17	97	90
Describe a plan of management for a paediatric problem which recognises the potential role of other health practitioners.	1	0	3	4	84	81	12	15	96	96
Select a physiotherapy intervention based on the best evidence available.	1	0	7	10	82	80	10	10	93	90
Identify how the selected physiotherapy intervention would be managed.	1	0	8	12	83	82	8	6	92	88
Identify how the effectiveness of the intervention would be evaluated.	1	0	10	6	83	80	6	14	90	94
Mean value (percent)									91.4	91.5

Table 2: Responses to questionnaire items pertaining to the Learning Experience: Phase 1 (Cohort 1).

The value for each response is presented as a percentage of the number of respondents for each item. There were 154 respondents; there was 1 missing data point for 5 items; and there were 2 missing data points for 2 items. Total Agreement is the sum of the values for Agree and Strongly Agree.

The unit of study has contributed positively to my future role because of my classroom exposure to, and experience of:	Strongly disagree	Disagree	Agree	Strongly agree	Total Agreement
Gaining confidence in coping with new/novel situations	0	17	73	10	83
Learning from comprehensive, real-life cases	0	4	75	21	96
A peer student taking on a facilitator role	3	27	61	9	70
The integration of core material from other subjects	0	16	75	9	84
Gaining confidence in my own resourcefulness	1	16	71	12	83
Utilisation of information technology	0	12	84	4	88
An environment of mutual respect between tutor and learner	0	7	82	11	93
Opportunities to develop skills in professional communication	0	9	79	12	91
Role plays	9	50	40	1	41
Evaluating my own performance	2	25	68	5	73
Evaluating my peers' performance	3	28	64	5	69
			Mean value (percent)		79.2

Table 3: Responses to questionnaire items pertaining to the Learning Experience: Phase 2 (Cohort 2).

The value for each response is presented as a percentage of the number of respondents for each item. There were 117 respondents; there was 1 missing data point for 5 items and 2 missing data points for 3 items. Total Agreement is the sum of the values for Agree and Strongly Agree.

The unit of study has contributed positively to my future role because of my classroom exposure to, and experience of:	Strongly disagree	Disagree	Agree	Strongly agree	Total Agreement
Gaining confidence in coping with new/novel situations	3	14	74	9	83
Learning from comprehensive, real-life cases	1	9	65	25	90
Resources made available in the classroom and in closed reserve	2	10	74	14	88
The integration of core material from other subjects	2	28	67	3	70
Gaining confidence in my own resourcefulness	1	15	71	13	84
Utilisation of information technology	2	13	68	17	85
Interactions between tutor and learner	3	28	58	11	67
Opportunities to develop skills in professional communication	4	41	50	5	55
Role plays	15	56	28	1	29
The case compilations as a record of my learning	2	15	70	13	73
The seminar presentation in normal development	1	5	79	15	94
Mean value (percent)					**74.4**

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cohort. These suggestions and changes and the evaluation by the subsequent cohort (Phase 2) are explored in the discussion.

Five key perspectives emerged from the focus groups. Consensus was achieved from responses that had been readily volunteered, without prompting. The perspectives were: (i) students understood the educational merits of PBL and appreciated the control that it gave them over their own learning, however, they needed more time to reflect and wanted opportunities to discuss what they learned and also the processes of their learning; (ii) students agreed that what they had learned in the classroom was beneficial for their clinical practicum and gave them increased confidence as practitioners; (iii) student perceptions of the on-line resources (including the discussion forum) were that they were additional to, rather than integrated with other resources material and tasks; (iv) students perceived the workload to be heavy; and (v) most students perceived assessments to be relatively fair, however, the peer and self-assessments were not considered credible.

Phase 2

A total of 118 students (62 per cent of the enrolled students) completed the questionnaire. Mean total agreement (agree and strongly agree) for the items pertaining to the overall unit learning objectives was 91.5 per cent (Table 1). Mean total agreement for the items pertaining to the processes of learning was 74 per cent (Table 3). For six of the items, the mean total agreement was above 80 per cent. The lowest total agreement was for role plays, at 29 per cent. Mean total agreement

for the helpfulness to learning of the website was 64 per cent. The highest total agreement was 83 per cent for the library information. The lowest total agreement was 40 per cent in support of the discussion forum.

Students' invited comments reflected their perceptions of the strengths and weaknesses of the revised unit of study. Aspects considered most helpful to learning were the student-led seminars on normal development; the problem cases being real-life, comprehensive and providing a holistic perspective; and the students learning to be resourceful. The assessment weighting of the case reports was considered to be too low. The overall workload was perceived to be too high, leaving insufficient time for preparation for the oral examination.

Discussion

This study sought to determine the success of a PBL unit embedded within a subject-based curriculum in terms of student achievement of prescribed learning outcomes and their acceptance of the educational approach. Because the study had two phases, this discussion focuses on the questionnaire evaluation of the first cohort (in Phase 1). Implications are also drawn from the evaluation of the subsequently changed unit (Phase 2). Although the focus group results were obtained after the commencement of the changed unit, they were consistent with the questionnaire findings and provided further insight into its success.

Achieving the educational goals

The achievement of prescribed learning outcomes is of foremost importance

in health professional curricula. In the current study, such achievement was determined from the rated perceptions of the students. The questionnaire results from the inaugural PBL unit of study (Phase 1) and the revised unit (Phase 2) indicated that the educational approach was effective in achieving pre-determined learning outcomes. Furthermore, the students' perceptions of their abilities were congruent with the fact that all students passed the unit of study and with the generally high mean level of achievement in the final oral examinations. Although there was no assessment of student ability in the clinical setting, the focus group report indicated that students attributed their enhanced sense of clinical competence in large part to their PBL experience. Dialogue between clinical educators and academics affirmed this perspective.

The current researchers were confident that the PBL unit of study succeeded in achieving other educational goals pertaining to professional competencies. The conclusion that the unit was successful in achieving the goal of fostering the skills of self-directed learning and applying knowledge to novel situations, was supported by the high mean grades achieved in all assessments, and most notably the high level of ability to reason and reflect upon learning that was demonstrated by many students in the individual oral examination. The students in the focus groups had specifically attributed to the unit their improved skills in clinical reasoning, and being more self-critical, reflective and self-directed.

Success for the PBL unit of study is in apparent contrast to a previous report. Boud and Feletti (1997) attributed

difficulties in introducing a PBL unit to mismatches between assessment methods and learning outcomes, evaluations that did not address key learning issues, and conflict as a result of being embedded within in a more traditional educational framework. The current positive outcomes may be attributed to many factors, including: careful attention to assessment planning; the design of the tasks in relation to each comprehensive real-life case scenario; the ongoing support and training of tutors; the monitoring of the quality of the student interactions in the tutorials; and the specific emphasis on synthesis and comprehension of knowledge by each student.

Student acceptance of an unfamiliar educational approach

As noted previously, there are particular challenges for students and for educators when units of study are embedded within an otherwise 'traditional' curriculum (Boud & Feletti 1997). Consequently, students may have competing learning agendas. The preferred style of learning for the individual student may not closely correspond to the PBL paradigm. In the current study, the 'suggestions for improvements' (Phase 1 questionnaire) indicated that an expectation to be self-directed and cooperative to complete the required (and self-determined) learning tasks, although liberating for many students, was challenging for a few, as indicated by the following comment:

> No matter what you think about adult learning, uni students are uni students and we are not responsible enough. We need a tutor, not a facilitator. Why

not utilise the tutor's knowledge and experience rather than us bumbling around the library wasting time.

A common feature of self-directed learning programs is that of website-supported learning. It should be noted that whilst the students were competent with computer technology, they had had no prior experience with web-based learning. Students from both cohorts indicated that the website was useful in their learning, in particular, the resources and website links that related directly to the case scenario. This finding is perhaps indicative of students whose learning tends to be goal-oriented. Although the website was accessed more than 35,000 times by the first student cohort, the discussion area was utilised infrequently (12 entries). Some comments in the Phase 1 questionnaire reflected the individual's lack of comfort with this medium. These findings suggest that not all students are prepared to undertake learning by this method or are willing to do so.

In both the Phase 1 questionnaire and the focus groups, students offered advice and encouragement to the current educators to continue to persevere with the educational initiative to facilitate student learning. Thus, despite the fact that the questionnaire sought suggestions for improvement rather than soliciting positive comments, students proffered comments, such as:

This subject has encouraged me to solve clinical problems by accessing resources and applying and developing clinical reasoning skills. In my opinion, fertile soil for future physiotherapy practice.

The many specific suggestions for improvement to the structure and process of the unit from the Phase 1 questionnaire demonstrated to the researchers that the students had insights into and an understanding of important features of adult learning. Several changes to the structure and processes of learning were made in line with their suggestions. These included providing more 'solid' information and direction at the outset, with the opportunity for an overall review of the 'important' information and 'key concepts' for the specific paediatric scenario under discussion. The specific changes included: conducting a practice case scenario in the introductory tutorial; the entire case module learning tasks being made available in the first week of each module; learning tasks being congruent with the criteria of the final oral examination (that is emphasising the clinical reasoning process), a concluding session for each case module with a guided review of learning processes and issues arising, and providing a composite summary from the student groups on the paediatrics website.

Changes were made to assessments. In the Phase 1 questionnaire students had commented frequently that they felt too rushed, preventing 'consolidation', 'learning', 'reflection' and 'digestion'. A reduction in the workload was achieved by reducing the case modules from six to five. Other changes included the removal of the peer assessment because of concerns about its lack of validity. Furthermore, there was a change in the respective weighting of the assessment components of the unit. The mark allocation for the group written reports covering the learning tasks and outcomes of each case module was increased to

acknowledge student value and effort.

No change was made to the learning strategy of the role play. This was despite its negative rating and the subsequent focus group feedback that students considered role playing to be over-used throughout their (entire) physiotherapy program. The educators believed that the role play task was valuable in achieving the relevant learning outcome/s in which students would learn about multidisciplinary health team membership roles and responsibilities by participating in a health team meeting role play. Despite expressed reluctance to undertake role playing, students participated in their role play with enthusiasm and were observed to be capable of blending learned theory in their problem solving while 'in role'.

Implications and limitations

A major reason for the development of this unit was to overcome the problems of the student being unable to synthesise previous and new knowledge from different sources and applying it holistically to a broad range of unfamiliar clinical scenarios. Whether the PBL unit was effective in this is not known. Neither did we determine the extent to which the PBL unit was more successful than the previous learning paradigm in preparing the students for paediatric or other work settings. However, the focus group report that the PBL experience gave students increased confidence in the clinical environment suggested that it was successful in overcoming shortcomings identified by novice graduates from the current program (Adamson et al 1996). It is noteworthy that positive attitudes to PBL have been reported previously, such

as greater enjoyment of a unit of study when compared to a traditional mode of teaching (Michel et al 2002). Although there was an apparent reluctance by some students to accept the new learning paradigm there was sufficient evidence from the questionnaire comments and the focus groups to indicate that most students had a positive attitude to their learning in this form.

Educator responsiveness to students' feedback may have positive influences on students' attitudes to learning as well as the effectiveness of their learning. Feedback from the focus groups in the current study indicated that students were appreciative that their recommendations would lead to future unit modifications. Furthermore, there was anecdotal evidence that the second cohort valued changes made in line with the suggestions of the first, and recognised the efforts being made to optimise their learning. Interestingly, the specific behavioural and learning benefits of increased motivation and in-depth learning have been noted to result when students participated in setting the curriculum within a collaborative learning environment (Clifford 1999). Periodic consultation with students is therefore recommended as confirmation of educator commitment to fostering student learning.

As responsible educators, the current researchers were confident that changes made to the structure and process of the unit of study did not have a detrimental impact on student learning. From the second cohort evaluation, there were further suggestions for change, the most common of which related to workload and marks, that is a reduction in work, allocation of marks according

to workload and removal of the self-assessment of clinical reasoning skills. Recognising the importance of avoiding student overload and stress, further changes were made to the unit, these were: the reduction in the number of case modules from six to five; a higher (relative) weighting for each case report, and the removal of mark allocation for the clinical reasoning skills self-assessment. Despite the limited acceptance of the role play in both student cohorts, the educators retained this specific learning method.

A specific goal of the PBL learning approach is that lifelong learning will be fostered. This PBL unit of study provided an educational climate in which enquiry, thinking and reasoning were emphasised. These attributes are the major determinants of whether graduates become lifelong learners (Candy et al 1994). There is conflicting evidence that metacognitive or deeper, reflective learning is easily achieved by PBL (Case & Gunstone 2002) and also whether positive attitudes to lifelong learning are fostered (Kwan 2001). In the current study, the researchers were encouraged by the fact that most students in both cohorts scored high marks on examinations that specifically promoted reasoning and reflection. Furthermore, insights were gleaned from the Phase 2 evaluation about the (three) aspects of the unit that students found most helpful to their learning. The students nominated as key positive features the student-led seminars on normal development, real patient scenarios with a holistic perspective, and their acquisition of skills in learning to be resourceful. These aspects were also noted in the focus group report.

Thus, these students identified desirable attributes of learning among those that they found helpful. Long-term follow up of the student cohort is required to determine whether metacognitive development or acquisition of skills in lifelong learning have ensued.

Conclusions

The PBL unit of study was successful in equipping physiotherapy students, that is, future health professionals, to deal with novel situations within the paediatric work setting. In particular, the students demonstrated encouraging attitudes to and achievement of skills in self-directed learning and clinical reasoning. The students also recognised the value of being encouraged to solve clinical problems by being resourceful. Despite the strength of the findings in support of this PBL unit of study, it is unlikely that all learners would perceive PBL to be optimal for their education or would declare a preference for it. The model of learning presented in the current study was embedded successfully within a traditional curriculum, with careful planning of content, process and assessment, and was achieved without increasing the demands of an already full curriculum. This paper presents a model for implementation that illustrates the potential strengths of PBL in fostering essential skills for professional practice and learning across a range of health professional programs.

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Appendix 1. Student evaluation form for paediatrics unit of study: Phase 1 (Cohort 1).

Evaluation	*PHTY 3038 PAEDIATRICS*
This evaluation seeks your opinions and feedback about this unit of study, overall. Your input is valued, as it will enable the paediatric teaching team to plan improvements. Please think carefully about your evaluation and your feedback. It is important that your comments, whether positive or negative, be informative, specific, and expressed in a way that will allow constructive use to be made of them. Please Indicate your agreement with the following statements	

Section A: Preparation As A Physiotherapy Professional

Consistent with the learning objectives, on completion of this unit of study I am now able to:	Strongly Disagree	Disagree	Agree	Strongly Agree
1. solve complex clinical problems accessing appropriate resources and using a process of clinical reasoning.	☐	☐	☐	☐
2. demonstrate an understanding of normal growth and development from conception to maturity.	☐	☐	☐	☐
3. discuss the occurrence of variations in normal development and possible reasons for these.	☐	☐	☐	☐
4. differentiate between normal and abnormal growth, development and function.	☐	☐	☐	☐
5. recognise the potential impact of abnormal development on the skeletal, respiratory and neurological systems.	☐	☐	☐	☐
6. recognise the potential psychological impact of illness, disease and/or disability on a child's family/ community.	☐	☐	☐	☐
7. describe a plan of management for a paediatric problem which recognises the potential role of other health practitioners.	☐	☐	☐	☐
8. select a physiotherapy intervention based on the best evidence available.	☐	☐	☐	☐

	Strongly Disagree	Disagree	Agree	Strongly Agree
9. identify how the selected physiotherapy intervention would be managed.	☐	☐	☐	☐
10. identify how the effectiveness of the intervention would be evaluated.	☐	☐	☐	☐

The unit of study has contributed positively to my preparation for my future role because of my classroom exposure to, and experience of:	Strongly Disagree	Disagree	Agree	Strongly Agree
11. gaining confidence in coping with new/novel situations.	☐	☐	☐	☐
12. learning from comprehensive, real-life cases.	☐	☐	☐	☐
13. a peer student taking on a facilitator role.	☐	☐	☐	☐
14. the integration of core material from other subjects.	☐	☐	☐	☐
15. gaining confidence in my own resourcefulness.	☐	☐	☐	☐
16. utilisation of information technology.	☐	☐	☐	☐
17. an environment of mutual respect between tutor and learner.	☐	☐	☐	☐
18. opportunities to develop skills in professional communication.	☐	☐	☐	☐
19. role plays.	☐	☐	☐	☐
20. evaluating my own performance.	☐	☐	☐	☐
21. evaluating my peers' performance.	☐	☐	☐	☐

What, if any, improvements could you suggest?

Section B: Paediatric Website

I found the following aspects of the paediatric website to be helpful in my learning:	Strongly Disagree	Disagree	Agree	Strongly Agree
1. The display of the unit of study outline	☐	☐	☐	☐
2. The display of the unit of study timetable	☐	☐	☐	☐
3. The Notice Board: "what's new?"	☐	☐	☐	☐
4. The Notice Board: problem case summary feedback	☐	☐	☐	☐
5. The listing of resource material	☐	☐	☐	☐