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Graduate qualities: Exploring problem solving in the applied pharmacotherapeutics curriculum at the University of South Australia

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Q2

Abstract

Embedding graduate qualities or attributes, such as problem solving capacity, into program curricula requires explicit identification to students of opportunities for development and assessment of these qualities.

In the University of South Australia Pharmacy program a multistage project was undertaken which firstly sought to identify student issues around problem solving ability. Secondly, in response to identified shortcomings, problem based learning was incorporated into applied pharmacotherapeutics courses. The third is the assessment of potential disadvantages to student subgroups such as non-English speaking and international students. Finally, assessment of whether students identified problem solving as an explicit process embedded in teaching methodology were undertaken.

This paper reports on the successful incorporation of a problem based learning tutorial teaching modality into applied pharmacotherapeutics courses. No student subgroups were identified as being disadvantaged by the introduction of this approach.

Keywords: *Graduate attribute, graduate quality, international, non-English speaking, pharmacotherapeutics, problem based learning*

Introduction

Since 1998, Australian Universities have worked towards the embedding of graduate qualities or attributes, such as capacity for problem solving into curricula. It is generally accepted that these qualities need to be developed within a discipline, and may involve “an active focus at the grassroots level to identify and map the opportunities for graduate attribute development across course (subjects, units) of study” (Bath, Smith, Stein, & Swann, 2004). Development of graduate qualities through a student’s program of study requires more than mapping opportunities for student development. It also requires that students’ “practice” behaviours undergo assessment within the course reviewed (Feast, 2001).

For Australian Pharmacy schools, the concept of graduate qualities or attributes aligns with the clearly articulated goal of educating prospective pharmacists

who possess both a sound pharmaceutical knowledge base and a set of skills to enable practice professionally. The Pharmaceutical Society of Australia in “Competency Standards for pharmacists” (2003) has outlined within their key statement for the profession “effective problem solving, organisational, communication and interpersonal skills, together with an ethical and professional attitude...” as essential to the profession of pharmacy.

This paper describes responses and assesses the impact of them. Members of the academic Pharmacy teaching team in the School of Pharmacy and Medical Sciences collected this feedback regarding concerns for graduate level Pharmacy problem-solving capacity. Of particular concern was ensuring that responses took into account the heterogeneous nature of the student cohort with respect to ethnic background, language ability and the requirement that the response be inclusive for all student subgroups. The resolution

included embedding opportunities for problem-solving practice and assessment in applied pharmacotherapeutics teaching modalities using problem-based learning (PBL) tutorials, lectures, practical sessions and clinical placements. Since undergraduate Pharmacy programs in Australia are presented over four years, the University of South Australia program structure emphasizes a science foundation in the early years and a therapeutics focus in the latter.

This is the first such report of the application of PBL strategies in a Pharmacy program in Australia.

Materials and methods

Several distinct methodologies were used in this study. Firstly, to gain an understanding of the problem solving skills of the graduates at the University of South Australia, informal focus group discussions were carried out with pre-registration preceptors and separately with pre-registrants (i.e. recent graduates) in 2003. It was considered that the pre-registration preceptors were in the best position to evaluate the graduate's strengths and weaknesses. The pre-registrants were also regarded as being in a good position to evaluate their own strengths and weaknesses.

Secondly, once accepted that students did not appear able to effectively apply their extensive theoretical knowledge to the practical setting, explicit "problem solving" teaching methodology and assessment was enacted. The third year applied pharmacotherapeutics courses were redesigned to incorporate PBL tutorials. Prior to 2004 these courses were delivered through several modalities including lectures, conventional tutorials and practical sessions. In 2004, PBL tutorials were added into this schedule of activities.

Ten pharmacists from local hospitals were recruited as clinical tutors and trained to run the PBL tutorial sessions. Academic staff experienced in PBL provided training to students. Tutorials (maximum 15 students per group) were conducted in the hospitals in the same week that students received relevant therapeutics lectures. During 2004, 11 PBL tutorial cases were developed and run over three or four two-hour sessions. Topics covered in the PBL tutorial included the following therapeutic areas—infected diseases, cardiovascular, respiratory, renal and endocrine.

Thirdly, to determine whether any student subgroup had been disadvantaged by the introduction of PBL tutorials, marks were compiled and analysed for student cohorts over the past 4 years in third year applied pharmacotherapeutics courses. For comparative purposes, results were also compiled and analysed for other third year courses. Only results for students who passed the courses were included. Final student marks for 2004 applied pharmacotherapeutics courses for each semester were compiled for the range of components that make up the final mark

of the course. Marks for specific 2004 exam questions which addressed problem solving ability and PBL tutorial performance were also analysed. Student's *t*-test was performed to assess differences in allocated marks. For analysis, students were grouped according to gender, home language and international or local student status.

Finally, students were asked to complete a paper survey requiring them to allocate an estimated percentage showing how problem solving skills and other graduate qualities contributed to the overall assessment of the course. The paper survey was distributed at the first lecture held in 2005, i.e. to those students ($n = 120$) who had satisfactorily completed all of the third year of the pharmacy program.

Results

The findings from focus groups of pre-registrant preceptors and pre-registrants were similar. Both reported that pharmacy graduates had difficulty applying their extensive theoretical knowledge to the practical setting.

This highlighted deficiency then led to the incorporation of PBL tutorials (Table I) into the third year applied pharmacotherapeutics courses. The PBL tutorial approach adopted in these courses focussed on therapeutics but also provided students with the opportunity to reinforce other discipline areas of the pharmacy curriculum such as pathophysiology, pharmacokinetics and pharmacology. As per the traditional PBL model, tutorials were formatted with insufficient information for initial solution of the case study at hand. Students were able to practice a diverse range of problem solving skills including differential diagnosis, evidence based drug selection and medication and lifestyle counselling.

Marks were compiled and analysed for individual semester courses including applied pharmacotherapeutics 300, applied pharmacotherapeutics 301, Molecular and Chemical Basis of Therapeutics 301 and Pharmacology 301 for four student year cohorts. Compiled marks for 2003 and 2004 applied pharmacotherapeutics courses are shown in Figure 1. Throughout all courses for which data was compiled and analysed several observations could be made. Firstly, marks did not change significantly in all

Table I. Key steps in the PBL tutorial process.

(1)	Case presentation
(2)	Identification of key information
(3)	Generating and ranking hypotheses
(4)	Review knowledge to refute or substantiate hypotheses
(5)	Generation of learning issues and reporting back
(6)	Reflection on learning objectives
(7)	Individual feedback

Q1

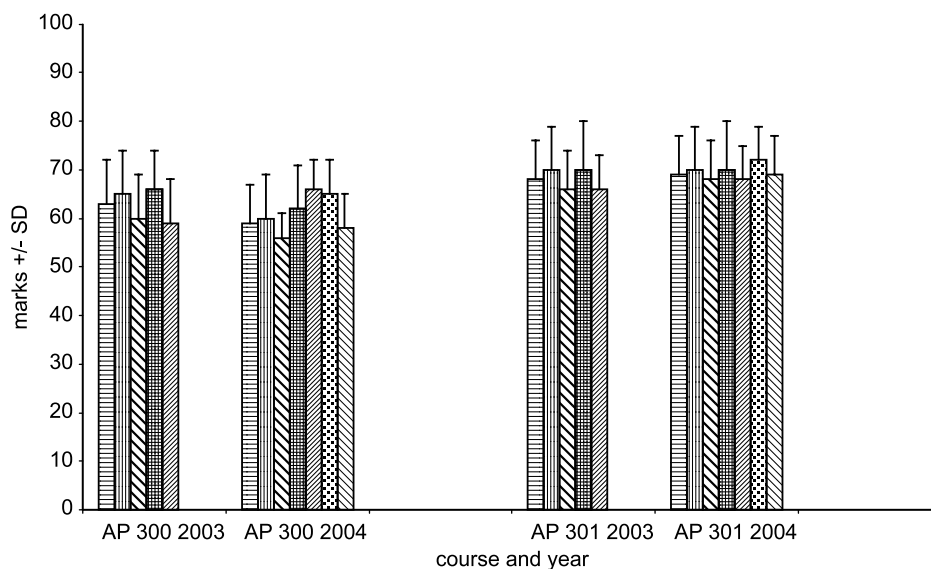


Figure 1. Marks in two applied pharmacotherapeutics courses (AP 300 and AP 301) in 2 years 2003 and 2004. PBL tutorials were introduced in 2004. Student groups are shown as overall, female, male, local, international, English speaking background, and non-English speaking background, respectively. Data were not available for home language of 2003 students. There were no statistical differences between marks achieved for students in any subgroup in each course.

courses from year to year (data shown only for applied pharmacotherapeutics 300 and 301 in 2003 and 2004). Secondly, female students tended to perform better overall than males, although this did not reach statistical significance. Thirdly, there was no clear trend for either local students outperforming international students or vice versa or English speaking background students outperforming non-English speaking background students or vice versa in any of the documented courses.

Marks were compiled for specific assessment components in one of the applied pharmacotherapeutics courses (Table II). Several observations can be made. Firstly, female students tend to perform better than do males, although this does not reach statistical significance. Secondly, the comparison between international and local students and English speaking background students and non-English speaking background students is consistent with the observations from Figure 1, i.e. there are no clear trends with one

Table II. Compiled marks for individual exam questions* (Q1, Q2, Q3 and Q4) and PBL performance in one of the applied pharmacotherapeutics courses in 2004.

	Q1/20	Q2/20	Q3/20	Q4/10	PBL tutorial performance†/10
All students	15.0 ± 2.6 (n = 141)	14.3 ± 2.1 (n = 139)	13.7 ± 4.3 (n = 139)	8.3 ± 3.3 (n = 141)	8.4 ± 1.3 (n = 144)
Female‡	15.3 ± 2.5 (n = 92)	14.4 ± 2.1 (n = 90)	14.2 ± 4.1 (n = 90)	8.8 ± 3.0 (n = 90)	8.6 ± 1.3 (n = 93)
Male‡	14.4 ± 2.6 (n = 42)	13.9 ± 2.2 (n = 42)	12.8 ± 4.8 (n = 42)	7.3 ± 3.8 (n = 42)	8.1 ± 1.4 (n = 45)
Local‡	14.9 ± 2.5 (n = 71)	14.5 ± 2.2 (n = 69)	14.1 ± 4.4 (n = 69)	7.8 ± 3.4 (n = 69)	8.7 ± 1.2 (n = 72)
International‡	15.3 ± 2.6 (n = 67)	14.3 ± 2.1 (n = 67)	13.3 ± 4.3 (n = 67)	8.8 ± 3.1 (n = 67)	8.1 ± 1.3 (n = 68)
English speaking BG‡	14.9 ± 2.7 (n = 35)	14.6 ± 2.2 (n = 33)	13.1 ± 4.9 (n = 33)	8.2 ± 3.4 (n = 33)	8.8 ± 1.3 (n = 35)
Non-English speaking BG‡	15.2 ± 2.4 (n = 105)	14.2 ± 2.1 (n = 105)	14.1 ± 4.0 (n = 105)	8.4 ± 3.3 (n = 105)	8.3 ± 1.3 (n = 97)

* In each question a case study was presented. Problem based questions (a combination of multiple choice questions and short answer) were asked addressing issues raised.

† PBL tutorial performance (assessed on communication and presentation skills, level of participation and knowledge gleaned from prior learning and researching available literature).

‡ Student records were accessed to determine gender, local or international student status and home language as either English speaking or non-English speaking background (BG).

group outperforming another. PBL performance marks, however, were higher for local and English speaking background students than International or non-English speaking background students, respectively, although this does not reach statistical significance.

A paper survey auditing student perceptions of the assessment activities in third year applied pharmacotherapeutics courses was completed by 62 students (50% of the relevant student group completed the survey). Their perception was that $16 \pm 7\%$ of assessment modalities specifically addressed problem solving. Results indicated students' viewed this proportion of the assessment as directly related to the University of South Australia graduate quality three, "A graduate of the University of South Australia is an effective problem solver, capable of applying logical, critical and creative thinking to a range of problems". The students' survey included advice to the students regarding perceptions that if only "body of knowledge" was examined all other graduate qualities would score zero whilst body of knowledge would score 100%.

Discussion

The focus group reported that both pre-registrants and pre-registrant preceptors believed pharmacy graduates had difficulty applying their extensive theoretical knowledge to the practical setting. Although, the Pharmacy program at the University of South Australia uses problem solving as an active and self-directed approach in teaching courses in the early "science" years of the program, for example, in mathematics and statistics, subsequent informal review by academic staff indicated that problem solving strategies did not contribute significantly in teaching third or fourth year applied pharmacotherapeutics courses.

A wide ranging case has been presented over the last 10–20 years for an active learning approach which encourages and supports "life-long learning". In such an approach there is the provision of opportunities for synthesis and structuring information such as in the PBL tutorial format (Biggs, 1999). PBL has become mainstream in medical programs in Australia, Europe, the USA, and the Middle East (Johnson & Finucane, 2000) and has been adopted in several pharmacy programs (Cisneros, Salisbury-Glennon, & Anderson-Harper, 2002) internationally. It is important to distinguish the implemented PBL tutorial format from the "pure" model (reviewed in Camp, 1996) in which the majority or all of the curricula are integrated into an interdisciplinary format. The PBL tutorial format adopted in the Pharmacy program is discipline focussed and individual tutorials are centred on specific therapeutic topics.

One of the major concerns with the introduction of the PBL tutorials was to be able to ensure success of all student groups through this approach. The third and fourth year of the University of South Australia Pharmacy program has a high proportion of international students, i.e. full fee-paying students who have relocated countries to study. There is also a high proportion (64% overall) of students in the program who indicate at enrolment that they have a home language other than English. Thirty percent of the students list a Chinese dialect as their home language and another 16% Vietnamese. Thus, the student group has a high proportion who may experience language proficiency problems. Along with learning styles and attitudes at odds with those of an English speaking background student who has matriculated within the Australian secondary system (Ballard, 1995).

Pharmacy students of primarily South East Asian, non-English speaking and/or international background are often stereotyped as passive, rote learners (Ballard, 1995). This is obviously incompatible in terms of self-direction and active learning required in PBL. Issues around PBL and student background have been examined in the case of medical education (Treloar, McCall, Rolfe, Pearson, Garvey, & Heathcote, 2000; Hawthorne, Minas, & Singh, 2004), however, no reports have been published with respect to this for Pharmacy programs in Australia or elsewhere.

The compilation of overall marks from four different courses over the past 4 years and compilation of marks in different problem solving questions in the applied pharmacotherapeutics 301 examination indicated that the introduction of PBL tutorials had not disadvantaged any student subgroup and that outcomes for students are the same irrespective of gender, visa or home language status.

The introduction of PBL tutorials into the applied pharmacotherapeutics teaching program met the objective of increasing emphasis on problem solving through both teaching methodologies and assessment in these courses. Staff used problem solving as an explicit teaching modality, whilst students were given opportunities to practice "problem solving", and were able to identify it in assessment of discipline specific materials.

Performance data of the 2005 cohort of fourth year students will be compared with data from the 2004 cohort to gauge the benefit of a PBL tutorial based program as scaffolding in preparation for the final year of the program.

Conclusion

Focus groups of pre-registrants and pre-registrant preceptors indicated that graduates had difficulty applying their extensive theoretical knowledge to the

practical setting. In response to these identified shortcomings, problem based learning tutorials were incorporated into third year applied pharmacotherapeutics courses. Analysis of student marks indicated that the introduction of a PBL teaching modality, which involves intensive group work and is strongly self-directed did not disadvantage any sub group of our heterogeneous study cohort. Importantly students identified problem solving as an explicit process embedded in the teaching methodology.

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