

ORIGINAL ARTICLE

Incorporating research training into undergraduate pharmacy courses: A case study from Australia

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Abstract

There is a dearth of research on the undergraduate research training provided to pharmacy students. We aimed to identify and provide examples of effective pedagogy in teaching research and evidence-based practice (EBP) to undergraduate pharmacy students. In conjunction with the professional competency standards for pharmacists, a review of the pharmacy workforce needs and the relevant pedagogical literature, a range of evidence-based approaches for selecting unit content, teaching and assessment strategies was identified. The authors reflect on the evidence and their multidisciplinary experiences in developing curriculum to demonstrate how pharmacy students can be engaged in deep learning rather than surface learning. Effective pedagogy in research training for pharmacy students will ultimately improve the quality of pharmacy education and the use of EBP principles in practice.

Keywords: *Pharmacy, research, teaching, undergraduate, university*

Introduction

Pharmacy education in Australia has moved through various stages from an apprenticeship model to a four year degree with an emphasis on integration of clinical and scientific knowledge (Roller, 1999). Pharmacy research has historically been primarily science-based including: drug synthesis, pharmacology, dosage forms, pharmacokinetics and drug delivery. However, pharmacists are more than dispensers of medicines. They need the knowledge, science and skills to ensure safe and effective provision of drugs and medicines in the community (Haines, 1988). The nature of community pharmacy practice is changing as pharmacists are more involved in pharmaceutical care, characterised by challenging and multidisciplinary

work. These changes require pharmacists to constantly access, interpret and use recently published research and be able to discuss this with other health professionals.

The role of the pharmacist as an educator is well recognised (Pharmaceutical Society of Australia, 2006) and the competency standards (Pharmaceutical Society of Australia, 2006) include primary healthcare roles such as chronic disease management, education, screening, and health education. In rural Australia the primary health care role is often enhanced by the shortage of general practitioners where pharmacists may be more heavily relied on as a source of pharmaceutical and medical information.

Increasingly, consumers are presenting to pharmacists with health information that they have accessed

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on the internet. Many pharmacists have not been educated to use the internet for professional practice (Bearman, Bessell, Gogler, & McPhee, 2005) and may view this information as unreliable (Williams & Wong, 2003). More than ever then, pharmacists must be able to critically appraise research reports and assess the claims of pharmaceutical companies, whether the information comes from the internet or from more traditional sources such as peer-reviewed journal articles or books.

The International Pharmaceutical Federation (FIP) recommends that pharmaco-epidemiology be included as one of the key areas of study in undergraduate pharmacy programs (FIP, 2000). However, in the UK, a recent review of approaches to teaching, learning and assessment in schools of pharmacy (Wilson et al., 2005) identified that research training ranged from formal classes to nothing at all, and that some students felt inadequately prepared for research projects (Wilson et al., 2005). Not surprisingly, researchers have reported that evidence-based practice (EBP) is poorly understood and utilised by some pharmacists (Watson & Bond, 2004) and it has been reported that some pharmacists regard customer feedback and personal experience as EBP (Watson & Bond, 2004).

There is a dearth of research on the undergraduate research training provided to pharmacy students to ensure that they are able to interpret, critique and provide evidence-based consumer information. In this paper, we reflect on teaching research to undergraduate pharmacy students and provide examples of what content we include and how we incorporate EBP into our teaching (see Table I).

La Trobe University has five campuses across the state of Victoria. Bendigo is situated in central Victoria approximately 150 km north-west of the state capital Melbourne. The pharmacy course at the Bendigo campus of La Trobe University was initiated at the request of local pharmacists. They had experienced difficulties in attracting pharmacists to regional and rural Victoria and were concerned that the average age of rural practitioners was significantly closer to retirement age than their metropolitan counterparts. The University was asked to examine the feasibility of providing a pharmacy course in Bendigo. The Bendigo campus at that time had expertise in chemistry, pharmacology, physiology, psychology, public health, social work, epidemiology, health sociology and nursing and had excellent contacts in the local health network. The working party, with the support of the Pharmacy Board of Victoria and other industry bodies, concluded that the Bendigo campus was indeed capable of supporting a comprehensive pharmacy course with the added advantage of being able to include rural health expertise through the extensive rural connections of the allied health presence at the Bendigo campus and, of course, the

Table I. Content outline: research for undergraduate pharmacy students.

Topic	Lecture topics
1	Introduction to research in health. Qualitative and quantitative research
2	Quantitative research: study designs
3	Quantitative data collection and analysis
4	Qualitative research: theoretical frameworks
5	Qualitative data collection and analysis
6	Reviewing the literature introduction to critical appraisal—developing critical appraisal skills
7	Behavioural and cultural issues—influences on patient drug taking behaviour and influences on prescribers
8	Introduction to EBP
9	Criteria for establishing causality in health research
10	Ethics in health research
11	Matching research questions with research designs pharmacoepidemiology—definition, drug trials, drug utilisation studies
12	Bringing it all together: defining a problem, devising a search strategy, retrieving and critiquing evidence, making an informed decision
<i>Tutorial topics</i> (presented by students using examples from pharmacy practice in parallel to lecture program)	
1	Blinding
2	Intention to treat
3	Matching
4	Hawthorne effect
5	Rosenthal effect
6	Crossover designs
7	Limitations of Randomised controlled trial (RCT)
8	Absolute risk
9	Relative risk
10	Numbers needed to treat
11	Focus groups
12	In-depth and semi-structured interviews

regional and rural pharmacists themselves. The course began in 2000. Prospective students were (and still are) selected on academic achievement and interview with a small weighting applied to favour rural students. By increasing our recruitment of rural students we have increased the proportion of graduates who practise in regional and rural Victoria.

Selecting unit content

In recent years, there has been a stronger emphasis on improved learning outcomes in higher education (Commonwealth Department of Science Education and Training, 2002). One of the challenges in teaching research units has been to encourage learning within a group of students with diverse learning styles and needs (Edwards & Thatcher, 2004). Historically, pharmacy education has had a strong emphasis on unit content (Kaartinen-Koutaniemi & Katajavuori, 2006). However, content is more than actual material. It should also include educational philosophy, context, outcomes and methods (FIP, 2000).

Effective pedagogy (the art or science of teaching) focuses on deep learning instead of surface learning. Deep learning promotes the understanding of content whilst surface learning is more orientated to the completion of tasks, memorising and regurgitating information which is linked to low-quality learning outcomes (Biggs, 2003; Ramsden, 2003). At La Trobe, teaching is planned using the principles of good pedagogy. Students are provided with the unit aims and the rationale for each in the teaching and assessment material. In the following section we describe the aims of our third year pharmacy research unit along with a brief rationale for the inclusion of each aim and how this is linked to effective pedagogy.

Unit aim 1: Understand the role of qualitative and quantitative research paradigms in pharmacy practice and be able to explain the advantages and disadvantages of each approach

Teaching research methods should be done in an “integrated and complementary manner” (Tashakkori & Teddlie, 2003: 63). In our unit, qualitative and quantitative research is taught in tandem as we do not seek to reinforce the split between the two. One of the challenges for pharmacy educators stems from the fact that pharmacy research education has been traditionally based in the positivist scientific paradigm (Eakin & Mykhalovskiy, 2005) and undergraduate students who were required to have performed well in high school science are often not only more familiar, but also more comfortable with, and trusting of, quantitative approaches.

Unit aim 2: Be familiar with basic research terminology and understand commonly used study designs and data collection techniques

Pharmacists need to be able to draw on a range of different sources and types of evidence in order to make clinical judgements (Watson & Bond, 2004; Pharmaceutical Society of Australia, 2006). Training in research methods provides a firm base from which to better understand the evidence. In order to do this, pharmacy students need to be familiar with basic research terminology and methods. To promote higher order skills of interpretation and understanding, that is, deep learning (Biggs, 2003), students are required to prepare and give a short presentation about a research concept to the rest of the class. Peers are encouraged to ask questions and actively discuss the topic. We find that this approach reduces the problem of students simply “regurgitating facts” (surface learning) (Biggs, 2003) and alleviates the problem of a “crowded” curriculum. Students must also make their teaching materials available to each other as study aids, as each topic presented is considered examinable at the end of semester.

Unit aim 3: Be able to define EBP and explain the role of pharmacists in EBP

Evaluating and using research evidence in order to make clinical judgements is part of everyday pharmacy practice. EBP is a tool that gives clinicians the knowledge and the authority to determine both the limitations of a given piece of evidence and the consequences of applying that evidence in practice (Dawes, 1999). Professional practice standards require that pharmacists are able to evaluate information about medicines using EBP clinical guidelines (Pharmaceutical Society of Australia, 2006). We find that most students are able to define and cite “EBP” but prior to their involvement in the teaching and learning activities and assessment tasks in this research unit, are unable to apply the concept in practice.

Unit aim 4: Be able to critique pharmacy research papers

Critical appraisal involves systematically reviewing a published article to determine the quality and usefulness of the article (Dawes, 1999). Australian studies have highlighted the need for pharmacists to have skills in identifying and critiquing literature that consumers use for advice (Williams & Wong, 2003; Bearman et al., 2005). This is supported by the Pharmaceutical Society of Australia Professional Practice Standards that highlight the importance of pharmacists using evidence-based resources and their ability to critically interpret information to provide to consumers (Pharmaceutical Society of Australia, 2006). We provide students with the necessary research training that enables them to critique both qualitative and quantitative research papers. The critique of research is an area that is often overlooked in pharmacy research training (Jesson & Lacey, 2006).

Unit aim 5: Be familiar with the fundamental concepts of pharmacoepidemiology

The rapidly evolving field of pharmacoepidemiology highlights the importance of research training to pharmacy undergraduate students. In order to understand and apply population-based studies that involve drug utilisation and risk/benefits assessments of drugs, students need to be able to understand basic pharmacoepidemiology principles that are aimed at promoting effective use of medicines.

Unit aim 6: Understand relevant behavioural and cultural issues which influence patient drug taking behaviour and prescribing patterns

There is growing recognition of the role of qualitative evidence in pharmacy practice and we now see a range of community research exploring the social determinants of health, clinical decision making,

practitioner-patient interaction, patient experiences of illness, health care delivery and other social elements of health and health care appearing in pharmacy journals. There is an identified need for community based pharmacy research (Bond, 2006). Pharmacists with an understanding of research are more likely to endorse the importance of community research (Saini et al., 2006) while those who have not had experience of research are more likely to cite lack of time and remuneration as impediments to participation in research (Saini et al., 2006).

Teaching strategies

Student-centred approaches to teaching that focus on students' needs are linked to enhanced student learning (Entwistle, Skinner, Entwistle, & Orr, 2000; Ramsden, 2003). This approach is one of the key elements to good pharmacy education practice (FIP, 2000). Several studies have found that pure science lecturers are more likely to use teacher-centred approaches to learning than those from the social sciences (Prosser, Ramsden, Trigwell, & Martin, 2003; Lindblom-Ylänne, Trigwell, Nevgi, & Ashwin, 2006). In this approach, teachers focus on content and the factual information is emphasised. This leads to students taking a passive role to learning (Biggs, 2003) and does not promote skills for lifelong learning; something that is essential in pharmacy practice (Kaartinen-Koutaniemi & Katajavuori, 2006).

Student-centred learning means that students are active participants in their learning. For teachers, this approach includes building on students' previous knowledge, recognising different learning styles and including teaching strategies that promote deep learning instead of surface learning. For students, student-centred approaches include working in collaboration with other learners, understanding expectations, monitoring their own learning and making their own decisions about who they will work with in group settings (Biggs, 2003; Ramsden, 2003). In recognition of this we teach some sessions in group dependent formats that require the students to work together. For example, when we teach critical appraisal we distribute critical appraisal guides and sample papers that the students read and discuss in small groups. They then prepare group responses to complete the critical appraisal tools. We allow the students to self-select their groups and then provide both guidance and supervision of the sessions to ensure clear expectations of the process.

The teachers' and students' approaches to learning are linked in that the approach taken by teachers will direct students to adopt either deep or surface learning (Kaartinen-Koutaniemi & Katajavuori, 2006). To help ensure that lectures are interactive and engage the students we incorporate "speed dating" (Murphy, 2005). In such situations the lecturer introduces

a topic (for example, the definition of prevalence and incidence) and then the class has one minute to work with the person next to them to "speed date" and come up with an applied example (for example, a situation where prevalence data is most useful and another where incidence data is more useful). At the end of the one minute time period the lecturer randomly selects one "couple" to share their brainstorm with the class. The possibility of being called on to share an answer increases student motivation to participate. This strategy transforms traditional one-way lectures that encourage surface learning into interactive and engaging learning opportunities that promote deep learning. This is particularly important when the lecture is timetabled late in the day.

Inter-professional learning is promoted by ensuring that pharmacy students share some lectures with students from other disciplines. We find that tutorial groups are more effective if they are discipline-specific as this allows the group to focus on the context of the students' future professional practice. We also utilise the skills of staff from different Faculties across the university. As a rural campus we do not have access to a pharmaco-epidemiologist and instead utilise the expertise of the epidemiologist from the School of Public Health. This has the added advantage of providing students with both a public health framework and a clinical context for their practice.

Assessment

Effective pedagogy challenges lecturers to promote deep learning and therefore to ensure that assessment is an integral component of effective teaching and learning processes. We find that many students who are primarily "achievement" orientated, work "backwards" through the unit outline. That is, they determine their learning needs by focussing on what is required for assessment. We know that student motivation to learn is higher when the unit content is included in the assessment task (Crooks, 1988). Therefore, selecting appropriate assessment tasks is a crucial component to effective teaching.

The assessments undertaken by the students focus on the fundamentals of pharmacy research including research paradigms, data collection and analysis, and skill development in EBP in pharmacy research. There are three main components to the assessment for this unit which reflect the key principles of assessment in higher education (Crooks, 1988).

The assessments in this unit reflect deep approaches to learning (Ramsden, 2003) and are in contrast to the traditional assessment methods that promote surface learning (Biggs, 2003). It is neither realistic nor desirable to include *every* topic that has been covered in a unit. Instead, the emphasis in assessment should be on the key goals for learning and be linked to the unit aims and objectives (Biggs, 2003; Ramsden,

2003). These priorities help students focus their learning on key concepts and skills and also assist lecturers in ensuring that degree programs are based on professional and workforce needs (Talbot, Graham & James, 2007). We emphasise each area of content by providing one session that describes the pharmacy professional standards and how they correspond to both the content of the unit and research projects undertaken in the fourth and final year of the course.

Student presentation

The first assessment is a tutorial presentation prepared by the students which focuses on the fundamentals of pharmacy research. The students work in (self-selected) small groups to research a topic provided by the lecturers that focuses on a component of pharmacy research. The students then develop a tutorial session for their fellow students focused on that topic. The class provides feedback to the presenters and the session is graded by the lecturer. The students are provided with detailed marking and assessment guides before the tutorial session to assist them in understanding the criteria (Crooks, 1988). This assessment task requires the students to take responsibility for their own learning as well as for those of their peers. It also requires the students to develop or practice their group communication and negotiation skills. They frequently comment on the fact that being able to explain a research concept to others often requires a deeper understanding of the topic.

Critical appraisal

It is important for lecturers to choose assessments that meet professional needs and provide a balance between theory and practice (Crooks, 1988). The ability to critically appraise research is a key component of ongoing professional development and EBP for pharmacists. In recognition of this, the second assessment is a critical appraisal task involving a comprehensive understanding and critique of two pharmacy-related research papers (one qualitative and one quantitative). In order to undertake this task the students need to have a sound understanding of both research paradigms, data collection and analysis methods and to be able to apply the theory provided to an example from pharmacy practice. In this unit we refer students to the critical appraisal skills programme guidelines to assist them in appraising the papers (<http://www.phru.nhs.uk/pages/PHD/resources.htm>). The provision of an appraisal tool assists the students to develop their skills in critical appraisal and to understand the role of appraisal in research practice. We also provide sample model answers (Crooks, 1988). It is important to build on previous knowledge (Crooks, 1988) so we encourage

students to reflect back to the pharmacy mathematics unit (that covers both statistics and calculus) they have already completed to help them interpret and critique the results section of quantitative papers.

Class test

The third assessment focuses on an evidence and interpretation task in the form of a class test. This test is taken at the end of the course and is designed to assess the level of understanding of pharmacy research. The test involves a range of different question formats (from short answer to longer synthesis and interpretation tasks) focusing on all aspects of the research process taught throughout the semester. Whilst this test does examine basic skills and knowledge the longer questions requiring synthesis and interpretation assess understanding of the material taught (Ramsden, 2003). We ensure that students can see the relevance of the items being assessed by including questions based on recent media clippings and information downloaded from various health-related web sites. We tailor these questions to scenarios where the student is a community pharmacist and a customer has approached them with information from the media that they must then interpret and critique. Unlike exams that might be entirely multiple choice (Ramsden, 2003) this format of a class test assesses deep learning and the ability of the students to apply their understanding in a scenario-based task.

Quality assurance

Evaluating the quality of teaching and assessment from a students' perspective is an expectation at our university. Evaluations of this research unit over the past five years ($n = 224$) have clearly shown that the students see the unit as relevant and interesting (Table II). This data is supported by direct quotes from students (also provided on anonymous quality assurance (QA) surveys). For example:

"This was a useful and worthwhile unit"

"Critical appraisal skills will help us in our profession later in life"

"Content was relevant and very comprehensive. Provided a good learning atmosphere with tutorial/lectures".

Incorporating bi-directional feedback (that is from lecturer to student and vice versa) is very important in ensuring quality teaching and learning (Crooks, 1988). For example, feedback from students highlighted the difficulties they faced in applying generalised statistical theory (from a previous unit) when they were critiquing quantitative research papers. In response we increased the amount of time spent

Table II. Selected results from anonymous quality assurance surveys.

Item	Percentage of students indicating "often or always true"*
The unit was interesting	69%
I see the relevance of this unit to my course	75%
The assignments encouraged understanding	80%
I have developed skills needed by professionals in this field	98%
The innovative lecture format (such as speed dating) increased my interest in the unit	63%

*The number of students responding to each item varies as the items included in QA surveys vary from year to year. Some items were included every year ($n = 224$) and others may only have been included one and sample size may therefore be as small as 44.

on this topic and invited the lecturer from the statistics unit to have input in to the session to assist the translation of theory in to practice. This also assists with vertical integration of learning across the four years of the degree.

Conclusion

This paper describes an innovative, multidisciplinary research unit that has been successfully delivered to undergraduate pharmacy students in Australia. We believe that the effective use of research findings by pharmacists is largely attributable to their understanding and interest in research. Effective pedagogy will improve the quality of pharmacy education and the use of EBP principles in practice.

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