SAFE DISPENSING PRACTICE: DEVELOPMENT AND EVALUATION OF A BLENDED LEARNING TOOL TO ENHANCE DISPENSING IN PHARMACY PRACTICE EDUCATION

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Abstract

Objective

Prescription dispensing is one of the core functions of a pharmacist. It is a complex process that involves a range of cognitive and manual steps. Ideally, pharmacy students first need to perform basic dispensing data processing functions before proceeding to more complicated clinical interpretation functions. From a training perspective, it is therefore important to introduce the various steps to pharmacy students in a sequential and systematic way. The aim of this project was to develop a blended learning tool to be utilised by pharmacy students over consecutive years of their program and to evaluate the impact of the tool on students' knowledge, understanding and application of the dispensing process.

Method

In 2010, third year pharmacy students at Griffith University were randomised into four study groups, each with differential access to the blended learning tool. The tool consisted of two modules, demonstrating the stepwise actions required to interpret a prescription, initiate dispensing and systematically enter data. This phase of the study involved 128 students and through pre- and posttesting of their knowledge and understanding, the impact of the tool was evaluated as well as the effect of compulsory viewing sessions. The tool was then further enhanced to address more complex patient care dispensing functions, such as the recording of clinical patient interventions. The same cohort of students was exposed to the advanced tool in 2011. This phase of the study involved 105 fourth year pharmacy students that further evaluated the tool through post-testing of their knowledge and perceptions of these dispensing functions. Ethical approval was granted by the Griffith University Human Ethics Committee.

Results

The impact of the first phase tool was considered significant (p < 0.05 for both modules). Matchedpairs signed-rank tests compared the mean ranks of the groups that had access to the tool with the control group that had no access. With regard to the basic dispensing tool, it was found that the groups with access were significantly different to the control group (p = 0.001 and 0.009), demonstrating the effectiveness of the blended learning tool in improving dispensing procedure. Of the range of advanced dispensing functions later introduced to students, those functions of a clinical nature, such as recording patient allergies and recording patient interventions, were more highly valued by students than the advanced administrative functions, such as modifying Safety Net (p < 0.05).

Conclusion

Results showed a significant improvement of students' dispensing knowledge and skills due to implementation of the blended learning tool. Compulsory viewing of the first phase tool further impacted on students' knowledge gained and on their independent usage of the tool outside of structured workshop time. Importantly, student perceptions showed that those clinical functions of the second phase advanced tool that have a direct impact on patient outcomes were more highly valued than administrative functions, and consequently more likely to be utilised by them in their future professional practice, thereby improving patient medication outcomes.

Keywords: blended learning, dispensing, pharmacy practice, pharmacy education.

1 INTRODUCTION

Pharmacists in Australia practise under the purview of the Pharmacy Board of Australia, which is supported by the Australian Health Practitioner Regulation Agency (AHPRA), the national organisation responsible for registration and accreditation of health professionals across Australia. [1] Federal, state and territory legislation provides the regulatory foundation upon which pharmacy practice is based with the Pharmacy Board contributing to the development of standards, codes and guidelines for the profession. [2] The role and scope of the Australian pharmacist is guided by Codes of Professional Conduct and Ethics and a framework of Professional Practice Standards, outlining the qualities required of pharmacists to deliver acceptable and effective services. Additionally, National Competency Standards describe the skills and attitudes required of a pharmacist to provide safe and effective services, thereby delivering optimal health outcomes for patients. [3-6] These standards are published by the main professional organisation, the Pharmaceutical Society of Australia (PSA).

Pharmacy in Australia is a highly respected profession with pharmacists consistently rated by the public as one of the most ethical and trusted professions. [7, 8] The key role of a pharmacist is to review and supply prescribed medicines and medicines information, accurately reflecting a prescriber's intentions and consistent with the needs and safety of the consumer. [6] Pharmacists also prepare pharmaceutical products, promote optimal use of medicines and deliver primary and preventative healthcare. [4] In the context of an evolving health system in Australia, the role of the pharmacist is moving into new areas of responsibility, including limited prescribing, vaccine administration, chronic disease management and medication management. [9, 10] With more professional services offered in a variety of pharmacy practice and primary and secondary health care settings, the pharmacist's roles in the medicines management pathway are both well established and also still developing. [6] It is crucial that pharmacy education likewise evolve to provide relevance in courses and programs to meet the needs associated with emerging models of practice. [9]

Professional competence develops through experience acquired in practice, founded on core knowledge, skills and attitudes gained through university education [4]. Griffith University School of Pharmacy offers articulated degrees in Bachelor of Pharmaceutical Science and Master of Pharmacy that together enable graduates to complete an Australian internship to gain registration as pharmacists. Within the pharmacy program are sequential courses in Pharmacy Law and Practice and Professional Pharmacy Practice, across the third, fourth and fifth years of the articulated degrees, which aim to increasingly expose students to more advanced knowledge and complex skills relevant to the proficient practice as a pharmacist. These practice-based courses present a clear pathway of advancing skills and knowledge related to dispensing and medication management.

1.1 Medicines Management Pathway

The processes involved at all stages in the supply and use of medication are described in the medicines management pathway. [6, 11-14] A cyclical concept of interdependent stages in the management of medicines use has been proposed and constructed with a patient-centred focus. [11] Many of the technical and cognitive processes in the pathway involve the pharmacist, who has the unique knowledge and skills required to intervene in drug related problems (DRPs). [12] The term DRPs is inclusive of adverse drug events, errors in prescribing, dispensing or adherence. Errors in the medicines supply pathway can occur at all stages during the process, including prescribing, supply, administration, monitoring and documentation and have a significant impact on the individual consumers and contribute to iatrogenic illness, avoidable hospitalisations and death.[15] The steps in the pathway most relevant to a pharmacist's primary role are review of a medicine order, issue of medicine and provision of medicine information. [11] Following the completion of an Australian study that focused on the role of pharmacists in clinical interventions, the medicines management pathway was annotated with strategies to reduce DRPs, including those related to pharmacists' dispensing processes and software. [12]

Clinical interventions are defined as any process of identifying and resolving either an evident or a potential DRP and they are routinely performed by pharmacists in their professional role. [12] One of the major roles for pharmacists and other health professionals involved in the medication management cycle is to identify and resolve any evident or potential DRPs, effectively performing clinical interventions. [12] The PSA recently released the *Standard and Guidelines for Pharmacists Performing Clinical Interventions* which encourages pharmacists to focus more on this role and improve the recording of interventions.[13] Ideally pharmacists should work in partnership and communicate with other health professionals to reduce the occurrence of DRPs in order to improve

patients' health outcomes. This document gives detailed advice on the situations that may require interventions, actions that can be undertaken to resolve the issue, and the optimal way in which to record the intervention. [13] Pharmacist compliance with the new standard and guidelines has the potential to improve the quality of interventions performed leading to greater benefit to the patient and optimal use of medicines.

Of the numerous DRPs that can occur within the medicines management pathway, dispensing errors are those that occur during the supply phase of the process and are directly within the scope of influence of the pharmacist. A dispensing error may be defined as a deviation from an interpretable written prescription or medication order, or a deviation from professional or regulatory requirements. [16] They may be classed as selection, labelling or therapeutic errors. [17] Dispensing errors include the supply of the wrong medicine, strength, form or quantity of a medicine, or labelling a medicine with the wrong directions, or supplying a medicine beyond its expiry date. [17, 18] Issues that contribute to dispensing errors are look-alike medicine names and containers, sound-alike names, workplace staffing and shortcomings of computer software. [18]

A body of research has been conducted into dispensing errors, in both hospital and community pharmacy practice settings. [16-25] The Australian National Prescribing Service reviewed literature relating to community medication safety and identified a number of areas of pharmacy practice that contribute to increased risk of medication incidents, including poor communication with general practitioners, staffing levels and workplace systems. [15] Pharmacists are often required to function in their professional role under time pressure and whilst dealing with numerous distractions. One Australian study identified the following factors as the top five causes for dispensing errors identified by pharmacists, in order of most significant contributing factor: (i) high prescription volumes; (ii) pharmacist fatigue; (iii) pharmacist overwork; (iv) interruptions to dispensing; and (iv) similar or confusing medicine names. [26] Pharmacists are encouraged to implement good dispensing practice to minimise potential dispensing errors.

1.2 Dispensing Practice

Optimising good dispensing systems contributes to the Quality Use of Medicines (QUM). [6, 27-30] QUM is central to Australia's National Medicines Policy, aimed at improving the health outcomes for Australians, focusing particularly on access to, and appropriate use of, medicines. [29] Under this framework QUM means wise selection of management options, choosing suitable medicines and using them safely and effectively, and this definition applies to decisions pertaining to the individual and to the overall population. [29]

Pharmaceutical Defence Limited, representing the largest Australian pharmacy indemnity insurer, publishes guidelines for pharmacy staff on good dispensing procedures, procedures to follow in case of dispensing errors and a list of potentially problematic medicines with similar names, with a view to minimising dispensing errors. [27, 31, 32] It is crucial that pharmacists not only adopt good dispensing procedures but also a systematic approach to managing actual errors as well as near misses, to inform their practice so that corrective action can be taken in a proactive way. [30, 31] Both the Professional Practice Standards and National Competency Standards contain standards that directly relate to the dispensing of medicines by a pharmacist to promote the accurate and timely supply of medicines to consumers, and to minimise any potential for adverse patient outcomes and dispensing errors. [4, 6] Additionally, the Pharmacy Board of Australia has published *Guidelines for Dispensing of Medicines* that centre on safe dispensing, designed as an adjunct to the standards published by the profession. [30]

A number of pharmacy dispensing software programs are available for use in Australia, for both hospital and community pharmacy practice. These programs are primarily focused on the recording and labelling processes involved in dispensing and, particularly in community pharmacy, facilitate compliance with supply requirements under the Pharmaceutical Benefits Scheme (PBS). The PBS is an important part of the Australian social health system and assists in achieving the objectives of the National Medicines Policy. It comprises a Schedule of Benefits, listing medicines available to be dispensed to patients under government-subsidy. [33] The dispensing software programs enable the pharmacist to view a patient's dispensed history, access and record patient details. These are important functions from administrative and clinical perspectives. The programs facilitate the processing of prescriptions, providing labelled directions and cautionary advice, additional patient information such as Consumer Medicine Information leaflets and often allow for the automatic payment of prescriptions under the PBS to the pharmacy provider. Dispensing software may also

facilitate aspects of the pharmacist's role in relation to emerging areas of practice, such as recording and reporting of clinical interventions.

Teaching the core skills of safe dispensing processes and practice within a framework of quality medicine use is an important aspect of pharmacy education. Considering that technology is now a part of everyday practice, it is crucial that pharmacy students have the ability to utilise dispensing software as part of a competent dispensing process.

1.3 Aims and Objectives

The broad aim of this project was to develop a blended learning tool addressing the fundamental and more advanced aspects of the dispensing process over consecutive years of the pharmacy program. It was customised towards student learning of the dispensing process, from basic data entry to the more clinically focused tasks, and the utilisation of dispensing software. Ideally, pharmacy students first need to perform basic dispensing data processing functions before proceeding to more complicated clinical interpretation functions. From an educational perspective, it is therefore important to introduce the various steps to pharmacy students in a sequential and systematic way, to structure student learning to value safety and adopt good dispensing practices to contribute to optimal QUM and patient outcomes. With the aims to (1) provide a smooth transition from dispensing at university to the workplace, (2) facilitate students' familiarity with important pharmacy practice concepts, and (3) encourage students to take appropriate action if or when an error occurs, the blended learning tool was developed and tested.

The objective of the research was to evaluate students' knowledge, understanding and application of the basic process of dispensing in the first phase, to determine the tool's effectiveness and inform the development of the more complex second phase of the tool. The first phase also aimed to analyse the impact of compulsory viewing of the tool on student knowledge and understanding. The objective of the second phase of the project was to use the blended learning tool to expose students to more advanced functions of a software program, both administrative and clinical, and evaluate their perceptions of the value of such functions to their future pharmacy practice.

2 METHODOLOGY

This project involved one cohort of pharmacy students across two years of the pharmacy program at Griffith University. The first phase, conducted in 2010, primarily involved a quantitative methodology with randomised control groups used to assess the impact of the blended learning tool. Phase 2, conducted in 2011, adopted a more qualitative approach, assessing student opinion and perceived value of the advanced functions demonstrated with the blended learning tool. The project was developed in stages to enable initial evaluation of the phase 1 project, to determine the effect of the tool on student knowledge of the basic dispensing data entry functions, the outcomes of which then informed the development of phase 2.

A blended learning tool was developed to provide a valuable and engaging resource for increased student learning that could be presented during a scheduled on-campus class and also accessed in the student's own time off-campus. Blended learning is defined as the effective integration of technology with the various modes of teaching to enhance engagement and enrich quality student learning. [34-36] The tool was developed as Flash-based presentations, using iSpring® Presenter with Microsoft PowerPoint® with narrated instructions. The presentations were then mounted to the Blackboard® learning environment for further student access and application following the completion of data collection in both phases. The pharmacy dispensing software utilised in both phases of the project and presented in the tool was FredDispense®, a Windows based program targeted to Australian community pharmacy practice.

Ethical approval was granted by the Griffith University Human Ethics Committee.

2.1 Phase 1

Phase 1 of the study was conducted in March 2010 and involved 128 third year pharmacy students with no prior educational training in dispensing. The cohort of students was randomised into four study groups during their scheduled dispensing data processing workshops in the Pharmacy Law and Practice course, with each group having differential access to the blended learning tool. The tool consisted of two modules, demonstrating the stepwise actions required to interpret a prescription,

initiate dispensing and systematically enter data. To facilitate students' understanding and to demonstrate the correction of common errors found in practice, patient scenarios were designed and incorporated into both of the modules.

Module 1 presented the basic dispensing process, commencing with initial evaluation of a prescription, following the template utilised in the course's workshops addressing the following primary issues: (i) the seven legal prescription requirements in accordance with the Health (Drugs and Poisons) Regulation 1996 (Qld); (ii) PBS requirements; (iii) patient information; (iv) assessment of medicine information; (iv) the consideration of counselling tools; and (v) label generation and (vi) checking. The template prompted students to verify of all the requirements of a prescription. [37, 38]

Module 2 involved basic data entry using the FredDispense® dispensing software. A step-by-step approach was used to demonstrate how to enter patient, doctor and prescription information into the software. Students were then instructed on the selection of appropriate medicines, including strength, form and generic brands from the software database. The tool detailed selection of appropriate quantities, prescribed directions and authorised repeats prior to generating a label using the dispensing software. This module comprised a blend of FredDispense® screen shots, prescription examples and text diagrams. The workshops were interactive, enabling students to apply the steps as they were presented to facilitate their learning.

The control, group 4, had no access to the tool during the study period. Group 1 had access only online via Blackboard®. Group 3 received only the compulsory face-to-face interactive session, whilst group 2 experienced the learning tool in class and had the option of further viewing online (Table 1).

Randomised Group	Face-to-Face Viewing	Online Access
1		✓
2	✓	✓
3	✓	
4	Control	Control

Table 1: Level of access to blended learning tool by randomised study groups

All students underwent pre- and post-testing to evaluate the impact of the modules. Demographic information was also gathered, including students' level of experience, if any, with dispensing software. The testing and compulsory viewing sessions were conducted during structured workshops over a 3-week period. Through this evaluation students' knowledge of the dispensing process and its application were determined, as well as the impact of compulsory viewing sessions.

2.2 Phase 2

The second phase of the study was conducted in March 2011 and involved 105 fourth year pharmacy students who, in 2010, completed the one semester of basic dispensing data processing training. The cohort of students consisted of the same students that participated in the first phase of the study in 2010. The blended learning tool in phase 2 was also developed as two modules of Flash-based presentation. The phase 2 tool focused on more complex patient care dispensing functions, demonstrating to students a number of features that extend beyond basic data entry and prescription processing. The presentation comprised sequential screen images and verbal narration of the steps involved in these aspects of dispensing. These included a range of software functions that enable recording of additional patient information, patient history notes, patient allergies, clinical patient interventions and more detailed administrative functions.

Module 1 demonstrated many of the functions of the FredDispense® software available in the patient update area of the software program. These included recording patient allergies and administrative functions such as recording nursing home or hospital details, and patient account or health fund details. Also demonstrated were the maintenance of patient family details and modifying Safety Net functions, which are directly related to the recording and reporting requirements under the PBS. [39, 40] In practice these functions directly relate to patients' receipt of subsidised medicine by the Australian government. Module 2 comprised the functions of the software related to patient history notes, including the classifying and recording of clinical interventions.

The phase 2 modules were presented to students in scheduled dispensing workshops in the Professional Pharmacy Practice course, allowing student interaction with the tool. The students were evaluated through post-testing of their knowledge, attitudes and perceptions of these dispensing

functions. Although some quantitative data were evaluated for phase 2 the research focus was particularly qualitative with regards to the advanced dispensing functions. Of particular research interest were students' opinions on the perceived usefulness of these functions to their future practice.

Data collection was conducted following the completion of each of the modules. The software functions were evaluated through a series of questions relating to each of the individual functions demonstrated by the particular modules. Students were evaluated on their familiarity with a particular function, their opinion of the importance of the various functions to pharmacy practice.

3 RESULTS

3.1 Phase 1

The impact of the tool was assessed based on pre- and post-test results before and after viewing of the tool and compared using a one-way Analysis of Variance (ANOVA). The impact was considered significant as the p-values for both modules 1 and 2 were < 0.05 (module 1 p = 0.0006; module 2 p = 0.0002). The variation between the groups with regard to both modules was substantial. Mann-Whitney and Wilcoxon matched-pairs signed-rank tests were used to compare the mean ranks of groups 1, 2 and 3 with the control group (group 4). With regard to module 1, it was found that the groups with access to the tool, groups 2 (p = 0.001) and 3 (p = 0.009), were significantly different to the control group, but group 1 was not (p = 0.838). This demonstrated the effectiveness of the tool in improving dispensing procedure and also showed the positive impact of compulsory viewing in learning outcomes. For module 2, it was found that group 3 was significantly different to the control group (p = 0.002), but groups 1 (p = 0.346) and 2 (p = 0.108) were not significantly different to the control group. Figure 1 is a graphic representation of the analysis.

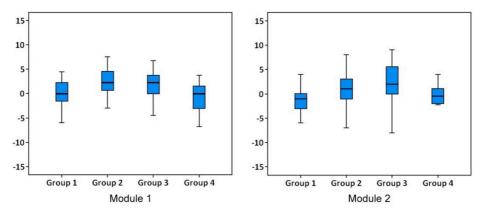


Figure 1: Phase 1 results for impact of tool in modules 1 and 2

3.2 Phase 2

Students' knowledge and perceptions of seven different functions were assessed in phase 2. The functions were those that enable recording of (i) additional patient information, (ii) patient notes, (iii) patient history notes, (iv) patient allergies, (v) clinical patient interventions, (vi) patient family maintenance and (vii) modifying PBS Safety Net information. Of this range of advanced dispensing functions, those functions of a clinical nature, such as the recording of patient allergies and clinical interventions, were more highly valued by students than advanced administrative functions, such as modifying the Safety Net (p < 0.05). However, overall students' responses with regard to future utilisation of the seven functions were very positive. Table 2 is a summary of their intention to increase use of these seven functions in the future.

Table 2: Future utilisation of the advanced functions

Function	n=105	% Agreed
Recording patient allergies	101	96.2%
Recording extra patient information	92	87.6%
Family maintenance	99	94.3%
Modify Safety Net	100	95.2%
Recording patient interventions	95	90.4%
Recording patient history notes	97	92.4%
Recording patient notes	99	94.3%

Themes that emerged from the study included:

- 1) students' increased awareness of the existence and application of the advanced functions, and,
- 2) students' appreciation of the benefit of the functions towards improved patient outcomes.

The usefulness of the tool was confirmed in student comments, including: "concise, simple, helpful, very practical", "it's clear and easy to follow along with", "easy explanation & straight to the point", "pretty clear and easy to follow", "the methodical way it went about explaining everything in great detail", "very comprehensive" and "again, very good step by step guidance".

4 DISCUSSION

Safe dispensing practice was demonstrated and enhanced in students across two years of the pharmacy program as a consequence of the design and implementation of the blended learning tool. Results showed a significant improvement of students' dispensing knowledge and skills. Compulsory viewing of the basic tool further impacted on knowledge gained and on independent usage of the tool outside of structured workshop time. Importantly, student perceptions showed that those clinical functions of the advanced tool that have a direct impact on patient outcomes were more highly valued than administrative functions, and consequently more likely to be utilised by participants in their future professional practice, thereby improving patient medication outcomes.

The tool was developed in a structured way, with a specific emphasis to systematically introduce students to safe dispensing practice. Through the tool they were initially exposed to core dispensing processes and were gradually shown more cognitive clinical functions of dispensing, relevant to the emerging role of the pharmacist. Simulating professional practice is crucial to conveying the applicability and importance of theoretical learning and hands-on procedures. Student experience of relevance is indeed vital to consider in the design of learning and teaching tools and activities, as those that deliver real world meaning or application promote student engagement and encourage deeper learning [41]. Student feedback on the blended learning tool revealed the applicability of the learning outcomes to real world practice. An important approach to learning of students in a professional program such as pharmacy mirrors the outcome of that learning, in that students are learning a process of integrating theoretical and practical knowledge that will be fundamental to their professional practice [42].

The role of pharmacists has expanded over recent years towards a broader focus of overall medication management. The core function of pharmacists has always been to dispense medicine and provide medicines information, for which pecuniary compensation has been provided through dispensing fees under the PBS. Of particular significance to this research is the fact that the Fifth Community Pharmacy Agreement between the Department of Health and Ageing and the Pharmacy Guild of Australia provides for the payment to pharmacists to perform clinical interventions. This will be achieved as part of the implementation of the Pharmacy Practice Incentive Program. This will be an enhanced service over and above that associated with dispensing. The aim of this service will be to increase the number of clinical interventions provided, improve communication with patients and prescribers, provide integrated care from the pharmacy to the treating doctor, and complement other services such as in-pharmacy medication use reviews, home medicine reviews and dose administration aids. [43]

The Australian pharmacy profession recognises the need to adopt improved practice processes with respect to the provision and recording of clinical interventions. Pharmacists should also adhere to good dispensing practice to contribute to QUM and improve patient medication outcomes and safety.

5 CONCLUSION

Preparing future pharmacists for a rapidly changing role in a technologically advancing profession is of paramount importance to contemporary pharmacy education. Australian pharmacy practice is on the cusp of defining new roles for pharmacists and the profession needs to be properly equipped to face the challenges. One way to prepare for emerging scopes of practice is to develop and implement good systems and processes for both core and advanced professional functions. It is vital to imbed an awareness of the nature of these evolving roles in pharmacy education and to equip students with the knowledge and skills to adapt to a changing professional environment.

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