

1 **Education Case Study Reports**

2 **Reflection on Teaching Strategies for Pharmacy Students**

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# 1 Training Evaluation Reports

## 2 Reflection on Teaching Strategies for Pharmacy Students

### 3 Abstract

4 **Introduction:** Teaching should meet the needs of all types of learner present in the class  
5 room; the activist, the reflector, the theorist and the pragmatist who also have diverse  
6 backgrounds, levels of education and are from different age groups.

7 **Aim:** The aim of the four projects was to improve students' engagement and success.

8 **Method:** New teaching strategies were trailed to improve students' engagement and  
9 succusses with topics which according to their feedback were considered 'dry'. We flipped  
10 module/s or topics, used simulation and case or problem based learning; and group works to  
11 replace lectures. First, third and fourth year students were asked to prepare for the in-class  
12 activities at home using the lectures or simulation software.

13 **Results:** the strategies were effective in small class size of 15-20 students, improved  
14 attendance and participation, improved fail rate, however there was no significant change in  
15 final grades.

16 **Evaluation:** Reproducibility is an important part of the experiment which can demonstrate  
17 that the results can be trusted. Success of one or two cohorts are not sufficient to adopt a  
18 method of teaching. Ongoing evaluation is essential to eliminate the cohort related effects  
19 prior to implementation in 2016. However, it is not clear if the achieved results can be  
20 sustainable in larger classes.

21  
22 **Key Words:** Simulation, Flipping the Classroom, Pharmacokinetics, Clean Room, Palliative  
23 Care, Peer Review

## 1 **Introduction**

2 Almost all higher education programs have components considered ‘dry’ and challenging in  
3 which to engage students and maintain interest. Teaching and the development of knowledge  
4 needs to address the needs of all the types of learner present in the class room environment.

5 This classroom environment can be either a virtual online, a physical face-to-face or a mix.

6 Students’ ways of learning and participation vary, ‘the activist’ thrive on a challenge, ‘the  
7 reflector’ likes to research the answers before making decisions, the theorist is happier when  
8 things flow in a logical order whilst ‘the pragmatist’ likes to get straight to the point.

9 Applying a mix of delivery methods such as didactic, practical, tutorial, simulation, role-play,  
10 problem-based and case-based learning scenarios or self-directed learning and flipping the  
11 class can satisfy the majority of students’ learning needs. However a mix of assessment  
12 methods such as Multiple Choice Questions (MCQs), Objective Structured Clinical  
13 Examination (OSCE), viva voce (oral examination), essay writing, and oral presentation or  
14 group work will further allow students to succeed.<sup>1</sup> This has the potential to produce students  
15 who are “empowered to succeed.”

16 Such an approach is simple to describe but it requires time and resources to develop,  
17 compared to delivering a lecture out of textbook or running a traditional practicum.

18 A mixed approach of teaching and assessment was tested in four different units within the  
19 undergraduate pharmacy program where the content varied from foundation knowledge to  
20 applied knowledge and from first year to fourth year units within the program. Within each  
21 unit evaluated, only one module was tested not the entire unit. All the units selected were  
22 those which are perceived as ‘challenging’ to engage with the students. Each unit will be  
23 discussed separately.

24 The projects were conducted to investigate the effect of engaging students into the learning  
25 process and to measure how this may affect knowledge retention and achievement. The effect

1 of allowing students not to only take active part in their learning process but also to take part  
2 in assessment of their peers. The hypothesis was that if students directed their energy to  
3 mastering knowledge rather than preparing for traditional exams they may become more  
4 engaged and participates better with their peers and in the learning process, leading to  
5 increased success. Project limitations were; firstly the class size, as our classes average of 15  
6 students and secondly that only one module in each of the four units was changed, not the  
7 entire unit.

8 The four units were Fundamentals of Pharmacy Practice, Advanced Pharmaceutics, Clinical  
9 Pharmacokinetics and Advanced Therapeutic (paediatrics, geriatrics, oncology and palliative  
10 care).

#### 11 **Aim**

12 The aim of the four projects was to improve students' engagement and success.

#### 13 **Method**

14 New teaching strategies such as flipping the class room, simulation, case and problem based  
15 learning, group activities and peer review were trailed to improve students' engagement and  
16 succusses with topics which according to their feedback were considered 'dry'. We flipped  
17 module/s or topics, used simulation and case or problem based learning; and group works to  
18 replace lectures. First, third and fourth year students were asked to prepare for the in-class  
19 activities at home using the lectures or simulation software. Innovative approached were used  
20 for each of the four units addressing the issue was most identified by students as being  
21 lacking; engagement for first year students, simulation and flipping the class room for third  
22 year two units and the fourth year unit. Within Australia, as in many other countries,  
23 educational audits such as this are deemed not to require ethics approval. These were small  
24 pilot audits of the effects of applying what are established practices and techniques in

1 education into new areas of the curriculum in order to improve the overall educational  
2 experience for the student.

### 3 *Process, results and evaluation of the four units*

#### 4 **First year: Engagement**

5 The foundations units cover topics such as the basic skills in weighing and measuring,  
6 extemporaneous preparation and how to use the dispensing computer program. They also  
7 learn the Australian pharmacy regulations, the national health policy and guidelines, the  
8 structure and organisation of Australian health services, medical terminology and  
9 calculations. This unit is typically taught in the first year. These topics can be very dry and  
10 hardly engaging.

11 Firstly, after learning to weigh and measure, the usual white aqueous cream the students used  
12 to make was replaced by a “colourful aqueous cream” by using dark food colouring and  
13 aqueous cream adding visual appeal and facilitating assessment of adequate mixing. This  
14 makes the exercises fun but with a message of how using the right method of mixing can  
15 produce a safe product for the patient to use.

16 Secondly to develop medical terminology, Poll Everywhere™ (Chicago, USA), was used.  
17 This is an online poll questions system to collect instant, anonymous answers using mobile  
18 phones (SMS) and tablet devices(through the web), providing students the confidence to  
19 answer without the embarrassment of being seen to have been wrong, also allowing them to  
20 see how their knowledge compares with their peers. This proved effective and engaging.

21 Thirdly a proprietary dose-calculation computer game (IntelliLearn™, Adelaide, Australia)  
22 was used which was perceived by the student as a good and enjoyable educational experience  
23 preferable to working through lists of practice calculations. Finally, in week 11(the teaching  
24 semester is 12 weeks) students were divided into four groups of five students. Each group was  
25 allocated a case-study and three questions covering two topics out of those taught in the

1 semester to prepare a 30 minutes revision session on the two topics and present this to the rest  
2 of the class; this was followed by 30 minutes questions time. In a four hours seminar they  
3 helped each other in completing revision of the entire unit, with excitement and smiles  
4 expressed on their faces during the session.

5 **Evaluation:** While students' grades were not higher in the end of semester examination and  
6 compounding assessments when compared to previous year, students' participation and  
7 engagement was higher demonstrated by their attendance and in-unit analytics. The unit  
8 evaluation had no negative comments and students indicated high levels of enjoyment in the  
9 unit.

10 **Students' comments:**

11 *"This unit improve my knowledge about the pharmaceutical system of Australia"* Student 1.

12 *"The mini-tests, structure and learning outcome make this unit very easy to follow what is  
13 required to know for the final examination"* Student 2.

14 *"Interesting and stimulates people to study"* Student 3.

15 **Third year: Simulation**

16 The clean room simulation was first tested in 2013 and re-evaluated in 2014; and was fully  
17 implemented as part of the curriculum in 2015. Simulating the aseptic and cytotoxic  
18 dispensing processes prepares students with the core skills to work in a clean room suite after  
19 being formally validated later in their workplace.<sup>2</sup> The rationale for introducing this module  
20 was to enable students to understand the concept of working in clean room (both aseptic and  
21 cytotoxic), working in a in simulated laminar airflow hood and environment rather than in the  
22 classroom through a lecture.<sup>3</sup> This module is delivered as a series of practical classes with  
23 tutorials on theory of parenteral formulations and the necessary pH and osmolality  
24 calculations related to parenteral admixtures. This extends on into administration guidelines  
25 and how to determine compatibilities with infusion fluids and administration sites. Total

1 parenteral nutrition (TPN) for adults and neonates and the required calculations are practised,  
2 and then the “do not rush to crush” theory for medication administration via enteral feeding  
3 tubes.

4 Students’ were for the first time able to use and identify infusion fluids, syringes, needles,  
5 ampoules, vials; and understand the removal of particles and organisms with in-line filters.

6 Each student manufactured two TPN bags, one for an adult and one for a neonate, two  
7 infusion bags with cytotoxic (placebo) or aseptic admixtures and five preparations for enteral  
8 feeding. They also learned how to manufacture eye drops in aseptic environment and adjust  
9 pH and osmolality. Their successful application of aseptic techniques was confirmed with  
10 contact agar plates and broth transfers.

11 This module covered policies and standards, working in a laminar airflow work station, clean-  
12 rooms; personal protective equipment, cleaning before and after dispensing in the clean room,  
13 preparation of products, waste management, labelling and packaging and reasons for  
14 exclusions from working in clean room and cytotoxic preparation.

15 ***Evaluation:*** All students except one who failed to attend the final examination passed the unit  
16 with grade distribution superior to that prior to 2013. Students reported that the clean room  
17 simulation was an unforgettable and enjoyable experience, this feedback was consistent in  
18 2013, 2014 and 2015.

19 ***Students’ comments:***

20 *“The practicals are a good way to apply your skills and knowledge learnt in lectures. It was  
21 good to do the activities in the workshops on Fridays as it helped with problem solving skills”*

22 Student-1.

23 *“lecture, practicals and workshops are great way of learning calculation questions or case  
24 studies especially the drug compatibility exercise were very interesting”* Student-2

1     *“TPN practicals were good and helped with our theory learning. The assessment pieces*  
2     *contributed to my understanding of the unit. It was good that a realistic product form was used*  
3     *for practicals products instead of long and pointless practical reports”* Student-3.

#### 4     **Third year: Flipping the Classroom**

5     In pharmacokinetic classes, a variety of activities and technologies were applied. These  
6     included PowerPoint™ slides, and Poll Everywhere™ quizzes, computer simulation programs  
7     to calculate pharmacokinetics parameters and simulate the results by plotting into graphs,  
8     massive open online course (MOOC) video and in-class group problem-solving and  
9     calculations. Students were provided with all lectures, textbook and a CD which contained the  
10    entire lecture content, problems and the simulation program. This was to enable students to  
11    prepare for each class at home. Then in class the lecturer provided quick revision of material  
12    and formulas during the 30 minutes, followed by calculations and problem solving for the rest  
13    of the class (90 minutes). This was conducted twice a week. Additionally, in the first week of  
14    the semester, students were provided with list of medications which have a therapeutic drug  
15    monitoring requirement to select one for individual oral presentation. For ten weeks they  
16    continued to apply the theory they were learning each week, to their drug. This led to oral  
17    presentations and a written report on their selected medication, covering the drug’s  
18    pharmacokinetic and pharmacodynamic profile. Presentations were at a show-case all day  
19    seminar, at week 11. Presentations were peer-reviewed using a rubric provided at the  
20    beginning of the semester to guide preparation of their drug profile. The lecturer also marked  
21    the work. Twelve drug profiles were taught to the students by the 12 students, slides and  
22    reports were made available to all students after the presentations concluded as study  
23    resources. This opened dialogue between the students during the semester, as each of them  
24    became the expert on that drug. This was an extremely positive outcome as communication



1 was extended to all the topics of the unit not just that drug. All the medications presented  
2 were included in the final exam.

3 **Evaluation:** This approach, plus the use of technology and simulation<sup>4,5,6</sup> made an otherwise  
4 very dry topic, fun and enjoyable. Students' results in the final examinations improved when  
5 compared to previous year (100% pass in 2015, 94% pass in 2014, 86% pass in 2013 of all  
6 students submitted the final examination).

7 Students' feedback was that the unit is taught in a "less threatening environment" as they  
8 practiced all types of assessment questions during classes.

9 **Students' comments:**

10 *"Combination of lecture, tutorial with PK software provided more than adequate learning*  
11 *resources"* Student 1.

12 *"Allows for studying at own pace"* Student 2.

13 *"The assigned textbook was really helpful when studying for calculations as it provided the*  
14 *answers for the example questions. The CD that came with the textbook was also helpful as it*  
15 *reinforced the concepts learned in lectures. The online videos also helped to reinforce the*  
16 *information that was taught in lectures"* Student 3.

17 *"The individual drug assignments were a good assessment and the whole day allocated to*  
18 *the presentations was interesting and helpful"* Student 4.

19 **Fourth year: Mixed Approach, Case Study Based- learning and Flipping the Classroom**

20 Another problem unit was an integrative therapeutics unit pulling together gender-specific  
21 conditions, life stages (paediatrics/geriatrics) and palliative care. This unit was found to be  
22 emotionally stressful for many students, not only on personal level but also as it is taught in  
23 the final semester of their degree where students are already stressed.

24 The national palliative care program, Palliative Care Curriculum for undergraduates  
25 (PCC4U™ Brisbane, Australia)<sup>7,8</sup> is primarily designed for medical and nursing students.

1 Traditionally pharmacy students were only introduced to the topic over two hours of lectures.  
2 In line with moves towards interdisciplinary learning the unit coordinator applied the PCC4U  
3 content with modifications to suit pharmacy students. The same cases were used but each  
4 patient in those cases was given a medications history. Students were paired in week-1: each  
5 pair, self-directed, studied one module or topic out of the eight offered in the online  
6 curriculum, and conducted a full medication review for the patient in the scenario from the  
7 treatment they hypothetically should be receiving at the time of choosing palliative care over  
8 treatment for cure. The medication reviews were to establish which medication should be  
9 ceased, and which medications should continue or should be introduced and why. Students  
10 then taught the topic they had studied to the rest of the class through their case, in a “*grand*  
11 *round*” style seminar. All students, 6 pairs, presented over one day in week 11, then peer  
12 reviewed each other’s using a rubric provided to them in week one. The slides and reports  
13 were made available to all students after the presentations concluded as study resources. All  
14 topics presented were included in the final exam.

15 ***Evaluation:*** All students enrolled in this unit passed the palliative care module and the unit,  
16 except for one person absent from the final examination. After the publication of the students’  
17 grades, students provided anonymous feedback as shown in table II. In the Course Advisory  
18 Group meeting, the current and previous students’ representatives commended the way this  
19 module was delivered. One student decided to undertake work experience in the palliative  
20 care ward of a public hospital as he believed that this would be an interesting work area for  
21 pharmacists which can be professionally satisfying.

## 22 **Discussion**

23 Adult learning is based on mutual trust and respect between educator and learner, openness  
24 and support by the educator and active inquiry by the learner.<sup>1</sup> Using multiple methods of

1 teaching delivery allowed the diverse types of learners to actively participate and improved  
2 their satisfaction rating of the unit content.

3 When the students were engaged in the teaching process, it was observed that their  
4 engagement with each other's presentations was higher than traditional lecturer presentations.  
5 Including the topic the students delivered in the unit assessment made it a real task and  
6 responsibility for the students to learn the topic very well themselves first before presenting.  
7 They also read about the topics and asked questions when other students were presenting, as  
8 they now perceived they had real need to know in order to be able to answer the examination  
9 questions later on. While the grade and number of students passing the units were either the  
10 same or only slightly improved, this may suggest that engaging students in the learning  
11 process improves competence and engagement rather than grades.

12 The students who were enrolled in those units were a mix of domestic and international  
13 students and from broad age group. While some students find it intimidating to present to the  
14 class, the majority of students reported that the activities boosted their confidence to speak  
15 which was noticed by other lecturers in other units, especially during their oral competencies  
16 and examinations. Being part of the assessment experience gave them a better understanding  
17 of how they are assessed by academic staff and where and why they did or did not do well  
18 and where they need to improve, directing their energy to mastering knowledge rather than  
19 just passing the next assessment.

20 As much as the pharmacist's skill of relaying information to patients is important, the  
21 accuracy of the information presented is paramount and it was essential to test the level of that  
22 knowledge, however the method of testing does not have to be traditional written  
23 examinations in a profession heavily depended on oral communication with patients and the  
24 healthcare team members.

## 25 **Limitations**

1 Our largest class was the first year 21 students the other three classes were 12-15 students  
2 each, it is not clear if student satisfaction, staff numbers and over all sustainability ) could be  
3 achieved in larger classes.

4 The lecture workload was not reduced, as to ensure that the content of the topics delivered by  
5 the students were complete and correct, topic objectives and salient points were developed  
6 and supplied to the students, and then were re-enforced by the lecturer at the end of their  
7 presentations. The flipping the classroom, simulation, and competency-based learning were  
8 tested and compared between two cohorts or more (2013, 2014 and 2015). Reproducibility is  
9 the most important part of the experiment to confirm if the results can be trusted. These  
10 approaches improved experiences in “challenging” topics.

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## PERSPECTIVE AND COMMENTARY

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### Reflection on Teaching Strategies for Pharmacy Students

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*Table 1 – Palliative Care Curriculum for Undergraduate (PCC4U) presentations pharmacy students' evaluation*

PCC4U Evaluation Questions	<8/10	>8/10
How new was this material to you?		12
How easy was it to understand?	2	10
How relevant was the content for pharmacists	1	11
<b>What do you think was the strength of the course?</b> <ul style="list-style-type: none"> <li>- Variety of learning materials written and videos</li> <li>- Regular revision in the class is really good</li> <li>- Great cases and videos, useful method for learning</li> <li>- Very well set out, I learnt a lot through these modules</li> <li>- I now understand patient and their families' need and the difference between treatment to cure and treatment to relief symptoms</li> <li>- Very well structured, interactive and improved my knowledge about oncology and palliative care</li> <li>- Content available online, extensive information and resources, the flashdrive provided was also very useful</li> <li>- Lots of supportive materials, easy to locate and research the topics</li> <li>- Interaction and communication with the lecturer was very important, reduced the stress , it was friendly approach helped me to study effectively without stress, I wish all therapeutics units are like that</li> <li>- Great information and references</li> </ul>		
<b>What you consider be the weaknesses of the course?</b> <ul style="list-style-type: none"> <li>- More than two people in the group would be good</li> <li>- Some aspects were difficult to understand as I never met real palliative patient</li> <li>- It took some time to understood the assessment</li> <li>- Emotional topics, but I understand we have to learn them</li> <li>- I think announcement to tell us the timeline would have been good to keep on track</li> <li>- The cases are provoking, but it is oncology and palliative issues after all</li> </ul>		

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