

Implementing a flipped classroom approach to a course module in fundamental nutrition for pharmacy students

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Abstract

It was evidenced that with active learning strategies, higher levels of learning outcomes could be achieved by learners. Healthcare professions including pharmacy education were among various disciplines that are best fitted to reap the fruit of active learning. Workshops and training organised by academic institutions are available to support educators in adopting active learning approaches into their courses. Consequently, in the 2015 academic year, the module 'Principle of Nutrition for Diabetes Mellitus' in the course 'Fundamental Nutrition for Pharmacists' was agreed upon to be the pilot for the flipped classroom approach, which was one strategy of active learning. Student performance as measured by final scores of the module was better than those for the same module taught with a traditional lecture in the preceding year. Students' evaluation of the flipped class was strongly positive in terms of knowledge gained as well as self-confidence in its applicability.

Keywords: Active Learning, Flipped Classroom, Inverted Classroom, Pharmacy Education, Thailand

Introduction

In 2015, the 2nd Annual National Health Profession Education Reform Forum (ANHPERF) took place in Thailand under the theme of 'Instructional Reform for Competent and Humanised Health Professionals'. It was a collaborative platform for all health science professions (including medical doctor, nurse, pharmacist, dentist, physiotherapist, public health personnel, veterinarian, from both academic and practice settings) to set up national policy for further development of all health professions' education. Areas covered in the forum included competency of learners, learning processes and learning environment (The Health Professional Education Foundation [HPEF], 2015). Active-learning was considered a cornerstone of health professionals' education. The participants were thus introduced to, and encouraged to apply, the concept and methods of active learning to promote students' learning experience and outcome.

In Thailand, medical education has been at the forefront in adopting active learning strategies (Khoo, 2003). Problem-based learning (PBL) is well known and well established in the education community of health professionals including pharmacy students (Barrow, 1996; Cisneros *et al.*, 2002; Kamran & Reicherter, 2003). The concept of other styles of active learning, such as flipped classroom and team based learning are novel to the pharmacy education community in Thailand. However, applications of the flipped classroom approach in pharmacy curricula and its evaluation were identified

elsewhere (Pierce & Fox, 2012; McLaughlin *et al.*, 2014; Schneider & Munro, 2014; Wong *et al.*, 2014; Khanova *et al.*, 2015; McLaughlin & Rhoney, 2015; Muzyk *et al.*, 2015). Positive learning experiences with the flipped classroom approach were reported in various courses in pharmacy curricula, namely renal pharmacotherapy, (Pierce & Fox, 2012), pharmaceuticals (McLaughlin *et al.*, 2014), pharmacokinetics (Schneider & Munro, 2014), cardiac arrhythmia pharmacotherapy (Wong *et al.*, 2014) neurologic pharmacotherapy (McLaughlin & Rhoney, 2015), psychopharmacotherapy (Muzyk *et al.*, 2015) as well as in other disciplines (Findlay-Thompson & Mombourquette, 2014; Gilboy *et al.*, 2015; Gross *et al.*, 2015; Jensen *et al.*, 2015; Mortensen & Nicholson, 2015).

The Faculty of Pharmacy, Thammasat University (Rangsit Center), was founded in 2013 and is the most recent pharmacy school in Thailand. The number of student admissions is regulated on the basis of FTES (Full Time Equivalent Students). Being a new programme provided a good opportunity to initiate innovative teaching methods. Following the 2014 workshop on active learning, the instructor team (in the Pharmaceutical Care division) agreed to implement an active learning method. The course 'Fundamental Nutrition for Pharmacists' for 2nd year pharmacy students was selected and one module, *i.e.* principle of nutrition in carbohydrate metabolism abnormality focusing on diabetes mellitus, was agreed upon for flipped classroom implementation.

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As students were accustomed to passive lectures in the traditional course, the present study was to introduce a flipped classroom approach into the selected module. Learners' performance based on exam scores, satisfaction, as well as their feedback on the new method were evaluated. Peer comment and feedback was also considered. To evaluate the new approach, it was designed that students' performance in the lecture class in the same module for the previous academic year were to be compared with that of the flipped class. Due to unavailability of results on students' satisfaction on the lecture class for the previous year, a comparison of these outcomes was not made.

Ethical approval was not sought as this was intended to be a topic evaluation after the end of the class which was considered a voluntary routine process.

A description of the traditional course and the flipped module in the course follows.

The traditional course

The course on Fundamental Nutrition is a one credit compulsory course in the Doctor of Pharmacy programme. It comprises 15 hours of in-class teaching, and 30 hours for self-study, in a 15-week semester. The course aims to equip pharmacy students with basic principles of healthy nutrition for the general public, as well as for some common diet-related diseases such as obesity, diabetes mellitus and dyslipidemia. When the course was first taught in the 2014 academic year (N = 21), a traditional lecture format was used for all modules, with student teams (groups of students) offering an oral presentation of their group work assignments as part of the assessment for the course. All students received the course syllabus describing course objectives, an outline of scheduled modules and sessions including guidelines on assignments and student assessment. Three instructors independently shared the teaching load for the course. Student performance was measured by a written examination comprising multiple choice questions (MCQs) and short answer questions.

The flipped module in the course

In response to health education reform and also instructors' participation in the workshop on active learning run by the University as mentioned, the outcome of the workshop was to see the number of courses applying an active learning method as a result of the instructor participation in the workshop thus the flipped classroom teaching was designed. A normal practice in the faculty was that for every course in the curriculum, student's feedback for the course as a whole was required, but to have students evaluate a module/topic an instructor was asked to do it for only one module/topic per semester. Conforming to this requirement, the flipped module was chosen to have student evaluate in the semester.

Pre-class preparation

In the 2015 academic year, for the selected flipped classroom module, a specific lesson plan was developed by the instructor to include learning objectives, module contents, selected pre-class self-learning materials, instructions on pre-class preparation, description of class activities including group work assignment, criteria for assessment of learning, and evaluation of student performance. The instructor selected and acquired self-learning materials from identifiable and retrievable sources without or waived copyright. A package of pre-assigned self-learning materials relevant to the learning objectives included five video clips (total time approximately 70 minutes) and ten pages of selected readings. The selected video clips were posted on the University Moodle platform where enrolled students (N = 29) were able to gain access. The reading materials were prepared and distributed as hard copies.

Two weeks prior to the class, the instructor met with the class. The lesson plan was given and the teaching method explained. They were informed of the video clips posted on the University Moodle platform, intended as pre-class self-directed learning. They were advised to watch them in recommended order. It was estimated that 2.5 hours would be sufficient for the students to prepare for each class. Students were also asked to form six groups of four-five students each. Each group was asked to prepare a PowerPoint slide set of photographs of their three main meals including any accompanying drink or side dish on any day before class. They were asked to bring the slides to class but were not aware of the purpose of the slide preparation.

In class activities

Each class was 100 minutes. Classes began with quizzes consisting of ten multiple MCQs (five minutes). In addition to being part of the total individual score achieved for the module, quizzes were also meant to ensure that students came prepared to the class. Two real life cases were then used for in-class discussion and problem solving (approximately 60 minutes.). To use the cases, the instructor initiated a question linking the cases with pre-class learning content (reading materials and video clips).

The class ended with presentation of group-work meal slide sets (approximately 30 minutes). Three groups were randomly picked by the instructor to present their slides. The class was not aware of the selection beforehand. The purpose of this activity was described. It was expected that the students were able to discuss the appropriateness of the meal in the context of diabetic patients. While a group was showing what they took for meals days prior to the class, the rest had to discuss whether food components in the meals were suitable for diabetes patients, in terms of nutrition types, especially carbohydrate component and what adjustment, if any, they would recommend. The instructor provided feedback promptly after each presentation and discussion.

The class activities were observed by two peer instructors who were not involved in the teaching of the course. Prior to the class, they were also asked to view the pre-class materials. The purpose of having independent peers observing the class was to obtain unbiased views on the flipped teaching on the part of instructors.

Evaluation and Discussion

On completion of the module, students were expected to achieve the learning outcomes in the level of knowledge, comprehension and application as referred to Bloom's Taxonomy of Learning (Krathwohl, 2002). The context under the application of knowledge and the understanding gained was related to patient care by the use of patient case-based scenarios in class. Thus the class also touched upon the human dimension and caring, the elements classified by Fink's Taxonomy of Significant Learning (Fink, n.d.). The component of flipped classroom was a self-directed learning method which represented "learning how to learn" in Fink's Taxonomy of Significant Learning.

Quiz scores and final exam test scores

Academic performances for the flipped module were based on quiz scores and module final exam scores, which were compared using the unpaired *t*-test to those of the same topic taught using traditional lectures to the class of previous year. The final exam included ten MCQs previously used as a quiz. The second patient case scenario used in the class session was slightly modified and included in the final exam. The students were to give short written answers for a series of questions at the end of the case.

Mean scores of the same ten MCQs tested at the beginning of class (7.45 ± 1.89 , range 2-10) and at the final exam (8.17 ± 1.44 , range 5-10) were not different statistically (pair *t*-test, $p=0.08$). Compared with the final test scores of students taught with lecturing method in the preceding year ($N=21$, 6.19 ± 1.76 , range 3-9), those of the flipped class ($N=29$, 7.24 ± 1.24 , range 5-9) were higher ($p=0.028$).

Students' feedback

At the end of class, students' feedback was collected anonymously by means of administering a questionnaire which consisted of 15 statement items representing six categories (Table I). A five-point Likert scale was applied to stand for 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree', in descending order. An additional column was provided for "not evaluable". The questionnaire also included open-ended questions about what they liked and disliked most about the flipped class.

Preference for teaching approach was divided equally between the flipped and the lecture classes but almost all agreed that they learned most from the flipped class. The highest scores (4.39 ± 0.62 and 4.25 ± 0.63) fell in the category of perception of gained knowledge, comprehension and its applicability.

Generally, most students did not feel time pressure with the flipped class. Responses towards the self-learning package were similar. The instructor role and class activities were rated positively.

Over half of the class agreed that the class activities were stimulating and over 80% agreed that their active participation was encouraged. Almost all students (up to 90%) strongly believed they could apply gained knowledge in giving dietary advices to diabetes patients. Although the positive responses could not be entirely attributed to the flipped component, it might indicate real-life case-based exercises in class could build students' application skills. Bishop & Verleger (2013) proposed that design of in-class learning experience may be a critical factor to determine the success or failure of the flipped classroom. It is thus important to recognise the value of active learning no matter what method. A robust study which compared flipped and non-flipped (non-lecture) methods while retaining similar in-class activities, demonstrated no difference in student learning outcomes and attitudes toward the methods (Jensen, Kummer & Godoy Patricia, 2015).

When asked what they liked most in the flipped class, the students' reflections were: active participation/interaction among class colleagues and the instructor, pre-class self-directed learning augmented comprehension with in-class learning, using case study reflecting real-life situation in the class, real life applicability of knowledge gained, and learning from group-work presentation in class.

On the other hand, what they felt most unfavourable were competing-like environment in class where one wanted to speak out but were just not quick enough to react (10), too many clip videos (3), and too much time spent on pre-class self-study (3). One student felt the objectives of the topic were unclear. Another student felt the quiz at the beginning of class was unfair as s/he wanted to gain more understanding from the class session before the quiz.

In the present study, not all students embraced the reversed classroom approach as mirrored in the feedback at the end of the module. This could be explained by diverse learning styles and one size does not fit all. In- and out of class learning in the present study offered blended learning materials, *i.e.* readings, video clips, featuring pictures/graphics, mini case studies as well as inter-personal communication, and group work. Although to our knowledge there is no evidence supporting the use of learning style assessment in instructional design (Pashler *et al.*, 2008). It might be useful to use a variety of teaching-learning approaches and tools.

Table 1: Students' agreement scores on the flipped classroom

Category	Statements	Average score \pm SD (max. 5)	No. of students strongly agreed/agreed (%)	No. of students being neutral (%)	No. of students strongly disagreed /disagreed (%)
Time spent and burden of task assigned out of class	Flipped classroom demanded too much time for self-directed learning	3.00 \pm 1.08	8(27.6)	13(44.8)	8(27.6)
	Group-work assignment was a burden	2.32 \pm 0.93 ^a	2(7.1)	9(32.1)	17(60.7)
	Too much time was spent for the topic	3.24 \pm 0.90	8(27.6)	16(55.2)	5(17.2)
Self-learning materials	The clip videos and the reading materials were too much	3.07 \pm 0.94	7(24.1)	15(51.7)	7(24.1)
	The clip videos and the reading materials were irrelevant to the topic	1.59 \pm 1.00	2(6.9)	2(6.9)	25(86.2)
	I enjoyed learning from the pre-class materials	3.24 \pm 0.77	10(34.5)	16(55.2)	3(10.3)
The instructor role	The instructor made this flipped class boring	2.28 \pm 1.20	7(24.1)	2(6.9)	20(69.0)
Preference for the flipped method	I preferred a flipped classroom over a lecture method	2.9 \pm 1.24	9(31)	11(37.9)	9(31)
	If the topic was taught with usual lecture method and slide lectures given, I would gain more knowledge	3.24 \pm 1.16	10(34.5)	12(41.4)	7(24.1)
	I gained less knowledge with the flipped method	2.1 \pm 1.06	5(17.2)	3(10.3)	21(72.4)
Perception of gained knowledge, comprehension and its applicability	At the end of the class, I am confident I would be able to provide basic dietary advices for diabetes patients	4.39 \pm 0.62*	26(93)	2(7)	0(0)
	At the end of the class, my knowledge and understanding increased	4.25 \pm 0.63*	25(89.3)	3(10.7)	0(0)
	I was uncertain the flipped teaching made me achieved the learning objectives	2.68 \pm 1.1*	6(21.4)	9(32.1)	13(46.4)
Class activities	Class activities were fun, made me active in class engagement	3.52 \pm 1.07	16(55.2)	9(31)	4(13.8)
	Class activities promoted students' participation	4.07 \pm 0.83	24(82.8)	3(10.3)	2(6.9)

*One student responded as 'not evaluable'

The present study and other studies differed in technologies used, types of learning materials, in-class activities and tools, and assessment. Several studies on the flipped classroom approach demonstrated improved student performance compared to the lecture method either in terms of final assessment (Pierce & Fox, 2012; Wong *et al.*, 2014; McLaughlin & Rhoney, 2015; Gross *et al.*, 2015) or after class testing (Mortensen & Nicholson, 2015). However, a flipped pharmacokinetics course only succeeded in demonstrating favourable student perception but not in their performances (Schneider & Munro, 2014), while a study on flipped neuroanatomy block teaching reported no difference in both measures (Whillier & Lystad, 2015). Among the studies, nutrition courses for nurses were taught with the flipped approach for the whole course in a larger class (Gilboy *et al.*, 2015). However, the study focused on learners' attitudes only without reporting the effects on student achievement. Another nutrition course in a pharmacy curriculum applied team based learning in

which a highly structured class format was designed, with a flipped element, illustrating both improved learning outcomes and student satisfaction (Pogge, 2013). This illustrates that one has to carefully reflect on what is being assessed: student motivation, all students' performance, certain students' performance, and/or satisfaction? An important assumption in flipped classroom applications is that students are motivated to prepare for class; our findings illustrate that this might not always be the case. A few students admitted they did not complete learning materials before coming to class, and this reflected in quiz scores at the beginning of class ranging as low as two out of ten. Students' motivation to complete, or not to complete, self-learning tasks has seldom been explored. Review of the flipped classroom study showed that students attending class unprepared was not uncommon. They preferred in person lectures to video lectures but favoured interactive classroom activities over lectures (Bishop & Verleger, 2013).

Peer observers' feedback

Two independent peer observers provided narrative feedback to the instructor. They felt impressed with the highly active participation of students in the class. Students' eagerness in class engagement was witnessed, which resulted in fruitful discussion. They believed that those who actively engaged in the class activities and had further queries were those who came to class prepared. They noted that from class activities the students generated further important relevant questions but beyond the scope set for the module. They considered this phenomenon desirable as it activated students' analytical thinking, curiosity and desire to search for answers, aside from the instructor's inputs. They also strongly recommended the instructor to find means to promote balanced participation among students.

Limitations

The direct comparison of the test scores between the two independent groups of students in different academic years in this study might not be considered appropriate for a number of reasons. Firstly, the test formats differed, with only MCQs used for the lecture method but with a short answer question added onto the MCQs for the flipped class. Using only MCQs, recall and perhaps guesswork might be encountered. The advantage of a short answer question is thus a more nuanced scoring compared to right or wrong for MCQs. This assumption was in agreement with Khanova *et al.* (2015) and might explain higher final exam scores in the flipped class of the present study. Secondly, although the module was taught by the same instructor, the learning material used for the lecture method was simply a lecture handout compared to a variety of learning tools in- and outside the flipped classroom. Therefore the results could be biased towards the flipped teaching. Better performance might be related to availability of wider types of learning tools, as also pointed out in another study (Gross *et al.*, 2015). Thirdly, baselines of the two student groups were uneven in their admission exam scores, with that of the flipped class students being higher than that of the previous year class *i.e.* the control group, which may have affected the results.

Future plans

Following the presentation of the results in an annual faculty seminar of knowledge management under the active learning theme, it is optimistic that other instructors learn and apply the flipped classroom concept in their courses. The model is to be continued for the same module of the course in the following academic year. Taking into account the students' feedback as well as that of peer observers, more efforts will be put in creating diverse learning opportunities and a rejoicing classroom atmosphere so that students could derive benefits along with joyful experiences which perhaps further offers a rationale to promote student engagement in shaping the learning process.

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