

## Flipped Classroom for Pharmacology Teaching in a Malaysian Medical School using Online Tools during the COVID-19 Pandemic: Knowledge Gained and Student Perception

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**Abstract**—Introduction: The usage of a flipped classroom to instruct medical students is becoming more common. During the COVID-19 epidemic, this method of teaching and learning proved to be effective. This study aims to analyse the knowledge gained and perceptions of medical students who were taught pharmacology in a flipped classroom utilising online tools. Methodology: A total of 50 second-year medical students took part in the research. Local anaesthetics and adverse drug reactions were the two topics covered in the flipped classroom. A few weeks before the session, pre-reading materials were distributed, which included voice-over PowerPoint videos and AMBOSS links. Students were given pre and post-tests using Microsoft forms to assess their knowledge gained during the face-to-face session. Higher-order thinking questions were uploaded as a Kahoot session, and the questions were also posted using Microsoft PowerPoint in an interactive session. A validated questionnaire was used to collect feedback, and the responses were graded on a 4-point Likert scale. Descriptive statistics were used to analyse the data. Results: There were 18 females and 32 males among the 50 students. The students' average age was  $21.4 \pm 0.6$  years. When the pre and post-test scores were compared, statistically significant results were obtained (P-value .000). The students had a favourable attitude about flipped classrooms. Most students said that the flipped classroom increased their understanding of the subject (mean score 3.760.44). They also thought the flipped classroom was a fun way to learn (mean score 3.710.47). The overall perception of the flipped classroom was excellent (53%). Conclusion: The knowledge gained by the students during the flipped classroom session in pharmacology was significant. The students had a favourable opinion of the flipped classroom method of teaching pharmacology.

**Keywords**—flipped classroom, pharmacology, medical school, online tools

## 1 Introduction

Intending to produce entrustable professional activities, medical education is now changing from a traditional objective-based curriculum to a competency-based curriculum [1]. Self-directed and lifelong learning are some of the abilities required for competency-based education. One method that supports self-directed and lifelong learning is the flipped classroom [2].

The flipped classroom is a type of learning activity in which students are exposed to instructional materials outside of the classroom and then apply what they have learned in class through problem-solving, debates, or discussion in the presence of the facilitator [3]. Eric Mazur promoted this technique, claiming that it benefits students threefold since it focuses on student and participatory learning [4]. The concept of a flipped classroom was first popularized in the United States. It was first launched in 1998, and it is based on the idea of moving lectures from inside to outside the classroom. This frees up time for hands-on learning. Students are focused on content application in class for a better comprehension of the topic. These tasks might be solitary or collaborative, making the lecturer more of a facilitator than an information source [5].

The purpose of a flipped classroom is to move from passive to active learning, allowing students to develop higher-order cognitive abilities such as analysis, synthesis, and evaluation. Pre-class assignments, in-class activities, and post-class activities are the three essential components of a flipped classroom [2][6]. Knowles defined flipped classroom as a technique that is aligned with andragogic methodology [7]. This method enables learners to get knowledge when they are internally motivated and within their personal and professional time restrictions, where the students study the materials as many times as possible before attending the face-to-face session [8].

Radio, audiotapes, and videotapes have all been used for distance learning for generations. However, with the emergence of the world wide web (WWW) at the end of the twentieth century, this teaching style has evolved [9]. Massive open online courses (MOOCs), recorded lessons, online live interaction, tutorials, and other online education activities are available. Some students and teachers, on the other hand, are opposed to online teaching and learning. However, with the outbreak of the COVID-19 pandemic, there has been a sudden and unavoidable shift in how teaching and learning activities are delivered [10][19][20]. The medical community has been perplexed as to which teaching-learning method is most beneficial in online education [21].

Due to the COVID-19 pandemic, our medical school, one of Malaysia's most prestigious private medical schools, had to make significant changes to our teaching and learning activities. The usage of flipped classroom as a teaching-learning medium for medical students was one of the changes. As a result, several of the topics in the department of pharmacology and therapeutics were changed to the flipped classroom to make teaching more engaging and promote active learning among our students.

### 1.1 Objectives of our study

- To analyse the knowledge gained by the students with the flipped classroom as a teaching modality in pharmacology teaching using online tools.

- To analyse the perception of the students regarding flipped classroom in pharmacology teaching using online tools.

## 2 Methodology

### 2.1 Study design

This was a pilot interventional study conducted on medical students in their second year in a Malaysian Medical school. The study's participants were picked via convenience sampling.

This session had a total of 50 students in attendance. Participation in the flipped classroom was entirely optional. Local anaesthetics and adverse drug reactions were among the topics covered in this session. These topics were chosen for flipped classroom conversion because they allow for a great deal of analysis, critical thinking, and clinical application.

### 2.2 Technology utilised in the session

A learning management system was used to upload the pre-reading material so that all students could access it. The synchronous online, face-to-face session was held using the Microsoft TEAMS platform. Microsoft forms were used for the pre-test, post-test and to collect feedback for the session. Microsoft PowerPoint and the Kahoot platform were used to run the interactive session in class.

### 2.3 The methodology used to conduct the flipped classroom session

**Pre-class assignment.** The students were given learning outcomes and pre-reading materials on the above topics. The pre-reading materials were uploaded to the learning management system at the start of the module. The materials included voice over PowerPoint videos and AMBOSS links.

**In-class session.** The students were given a pre-test that consisted of 5 OBA questions for each topic. Using Microsoft PowerPoint, the students were given scenario-based short answer questions to answer during the session, which assessed their critical thinking capacity. In addition, a Kahoot session with 10 OBAs was held. The lecturer discussed each of these questions, who also clarified any knowledge gaps on the topic.

**Post-class session.** The students were given a post-test with five OBA questions. Microsoft forms were also used to collect feedback on the session. A validated questionnaire was used to gather input. There were 13 questions in this survey, as well as space for free comments. The students were asked to express their opinions by selecting one of four options: strongly agree, agree, disagree, or strongly disagree, with scores of 4, 3, 2 and 1 correspondingly. The students' overall impressions of the session were assessed using poor, good, very good, and excellent.

**Analysis.** SPSS software, version 27, was used to analyse the data. The data was represented using descriptive statistics. The data was presented in the form of a mean and

standard deviation. The pre and post-test means were compared using a paired-sample t-test. A p-value of  $\leq 0.5$  was considered statistically significant.

### 3 Results

A total of 50 students participated in the study. Out of this, 18 were females and 32 males. The mean age of the students was  $21.4 \pm 0.6$  years.

**Table 1.** Paired sample t-test comparing the student’s performance before and after the flipped classroom session

	Mean	Standard Deviation	Standard error mean	t	df	Sig(2-tailed)
Pre test	3.84	0.12	.0775	-4.299	50	.000
Post test	4.17	0.09				

When we compared the mean between the pre-test and post-test scores, as indicated in Table 1, the difference was statistically significant (p-value .000).

**Table 2.** Perception of the students on the flipped classroom

SL no	Questions	Mean	Standard Deviation
1	The objectives were clearly defined	3.65	0.49
2	Participation in the session was encouraged	3.88	0.33
3	The topics covered were relevant	3.82	0.39
4	The contents were well organized	3.71	0.47
5	The contents were easy to follow	3.65	0.49
6	The prereading materials were useful	3.53	0.51
7	This flipped classroom improved my knowledge on the topic	3.76	0.44
8	This flipped classroom improved my fact retrieval skill from various sources-internet, books etc	3.47	0.48
9	This session improved my ability to face questions	3.76	0.44
10	Flipped classroom is a valuable learning activity	3.59	0.51
11	Flipped classroom was an enjoyable learning tool	3.71	0.47
12	Flipped classroom can be included as an effective learning method in the curriculum	3.59	0.51
13	It requires too much of time and is not worth all the effort	1.88	0.86

Table 2 shows that the students had a favourable impression of the flipped classroom. With a high mean score of  $3.88 \pm 0.3$ , the students felt that participation in the session was encouraged. They also thought the topics covered were relevant (Mean  $3.82 \pm 0.39$ ).

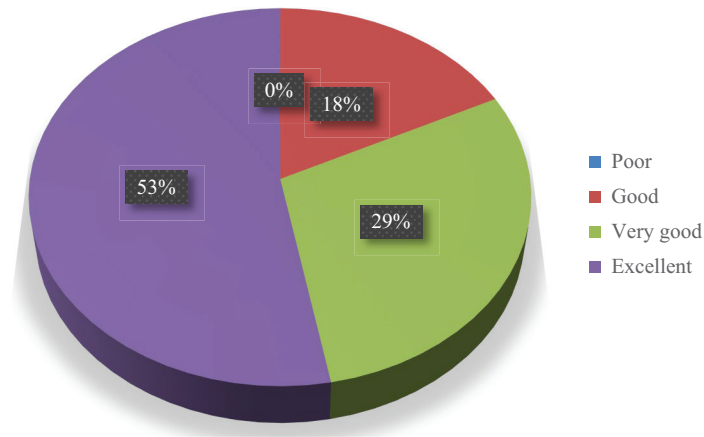


Fig. 1. Overall perception of the students regarding flipped classroom

Figure 1 shows that the students' overall perception was excellent (53%), followed by very good (29%).

Some of the opinions expressed by the students in the free comments were as follows: "It was a fun session, and it is easier to answer the post-test after class".

"Very engaging and interesting, lots of quizzes were useful and improved my knowledge. thank you so much!!)".

"I hope there will be more flipped classroom conducted for all the topics as this increase the productivity of students and help us revise the topic for the second time during the flipped classroom session".

#### 4 Discussion

The Coronavirus Disease 2019 (COVID-19) pandemic has wreaked havoc on medical education and healthcare systems worldwide. It presents challenges for medical education, as instructors must deliver lectures safely while maintaining the integrity and continuity of the medical education process. As a result, it is critical to evaluate the usability of online learning methods and determine their feasibility and adequacy for medical students [11]. Some of the most commonly proposed methods include scheduled live online video lectures with interactive discussions. Various programmes or self-study online recorded lectures are available online for medical students at each university [12].

In medical education, effective educational practices must include the following: the student should actively participate in the learning process; learning occurs independently and in collaboration with peers; pre-existing and previous knowledge serves as a foundation for acquiring new knowledge; learning should include real-life experiences; and the ability to reflect on the application of knowledge is important [8][19]. To encourage active and lifelong learning capabilities, medical educators must develop active learning methodologies. The flipped classroom has been demonstrated to be a successful instrument in medical education for achieving all these educational practices.

Although there are numerous advantages to learning in a flipped classroom, it is also a challenging method of instruction. When students have read the pre-class assignment and actively participate in the classroom discussion, this teaching-learning activity is effective. Unlike in traditional didactic lectures, where students are entirely reliant on lecturers to provide them with knowledge. Ensuring that learners learn before coming to the face-to-face session can be difficult, and it is dependent on the students' internal motivation [8].

The knowledge gained by students because of using the flipped classroom as a teaching-learning modality was examined in this study. There was statistical significance in the outcomes obtained. Ridell and colleagues conducted a crossover study to compare a flipped classroom with a traditional didactic lecture. It was discovered that statistically significant differences existed in the pre-test and post test scores among students who participated in a flipped classroom. In contrast, when they looked at how well students performed in flipped classrooms versus lectures, the results were not statistically significant [13]. The pre-reading materials provided to the students enabled them to understand the topics before attending the actual session. As a result, when they arrived in class, their prior knowledge assisted them in comprehending the concepts more effectively. The questions addressed during the interactive in-class session were primarily application-based and tested their ability to think analytically and critically. During the in-class activity, the students gained a more in-depth understanding of the subject matter. Studies have reported that flipping the classroom gives students more time for active participation and focused discussion [14]. According to Angadi et al., [15] flipped classroom as a teaching-learning strategy resulted in statistically significant differences between pre-test and post-test scores between students [15]. According to the findings of a study conducted on nursing students, combining new teaching techniques with interactive classroom activity resulted in improved learning outcomes [16][19].

The results of the study revealed that students were enthusiastic about the use of flipped classrooms. According to Nouri, a study was conducted among students enrolled in a research methodology course. When asked about the use of flipped classrooms, the students expressed a positive attitude, which was found to be highly correlated with perceptions of increased motivation, engagement, and effective learning [17]. This response could be attributed to the fact that, due to the pandemic, the lectures were conducted online, which can be monotonous and passive. Because of the flipped classroom introduction, learning became more enjoyable and interactive, particularly with the inclusion of Kahoot in the interactive sessions. Kahoot has proven to be a valuable tool for engaging students in learning [18].

The key reason for the flipped classroom's success as a teaching-learning activity is that students take charge of their learning. There are additional advantages, such as the fact that there is an active interaction between the students and the lecturers. The students are provided with the learning materials before the session, which allows them plenty of time to read at their own pace and in their own space before the session. Active learning and increased student engagement are encouraged because of this. There are some disadvantages to using a flipped classroom as well. For example, new technology can be problematic for both teachers and students to adjust to. Preparation of learning materials for the flipped classroom can take up more time for lecturers than learning materials for didactic lectures. In developing countries, the availability of technology can be a significant challenge.

#### 4.1 Limitations of the study

The study had a minimal sample size, which made it difficult to draw any meaningful conclusions. Only one medical school participated in the research. Therefore, the findings cannot be generalised to include all medical schools in Malaysia. To reach a significant conclusion, it may be necessary to conduct studies with larger sample size. A total of only two topics were investigated for this study. More topics can be included to strengthen our conclusions.

#### 4.2 Conclusion

The students' pharmacology knowledge increased significantly with the use of the flipped classroom model. Students had a positive attitude towards the flipped classroom.

#### 4.3 Recommendation

When teaching pharmacology to medical students, a combination of flipped classroom and the didactic lecture can be an effective combination. This will encourage students to participate in active learning and to be more engaged. Some topics in pharmacology can be chosen to be taught in a flipped classroom format to make learning more exciting and enjoyable.

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