

# Different perceptions of international MBBS students to flipped classroom model in comparison with native Chinese students in the Biochemistry module

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**Abstract**—In the past few decades, more and more international students have been studying in Chinese medical universities. This study aimed to examine the satisfaction of international Bachelor of Medicine & Bachelor of Surgery (MBBS) students in the 'flipped classroom' for medical courses and to analyze their perception in comparison to native Chinese students. The course chosen to evaluate the flipped classroom model (FCM) for students was Biochemistry. Seventy-seven second-year MBBS students and one hundred and seven Chinese students participated in the study module. Pre-class material was provided to study before class, while the in-class session included a pre-quiz, interactive lectures, and group discussions. A self-administered questionnaire was filled out by the students to check their perception named as FCM-perceived goals questionnaire (FCM-PGQ). Compared with Chinese group, which shows a positive response is 63.83%, 74.65% of international students show positive response and are more satisfied with FCM than Chinese students ( $p < 0.05$ ). This teaching model provided them benefits in cognitive effectiveness (78.4%), acquisition of student skills (76.2%), obtaining an advanced learning environment (76.7%), and better self-assessment & course evaluation/satisfaction (66.3%). It is noteworthy that one of the differences between international and Chinese students is their attitude toward time management of FCM. Chinese students think that the period taken by FCM is suitable, while international students think that FCM is a time-consuming method ( $p < 0.05$ ). Although it takes more time to fulfill the learning needs of international students,

FCM would be more helpful for international MBBS students in the Biochemistry course than for Chinese students.

**Keywords**—Flipped classroom model, international MBBS student, Chinese student, Biochemistry course, quality of teaching, medical university.

## I. INTRODUCTION

In the past few decades, with the deepening of globalization and the development of international students' education, more and more international students are studying in Chinese medical universities, [1], [2]. The provision of quality medical education to students is necessary to improve their professionalism and clinically applied skills. However, due to differences in educational background, some international students may not be able to learn medical knowledge in depth and connect classroom knowledge to medical applications, [3], [4]. Therefore, effective reform of clinical medical education for international students is necessary.

In 2000, a new model referred to as 'Flipped classroom model' (FCM) appeared, which motivated the students to have active learning with interactive sessions under the teacher's supervision. The FCM is a pedagogical model that emphasizes the student as the focus of learning, rather than the teacher as the focus of teaching. In simple terms, a traditional lecture involves the teacher giving a lecture, followed by homework, whereas in a flipped class, study materials are provided before the lecture.

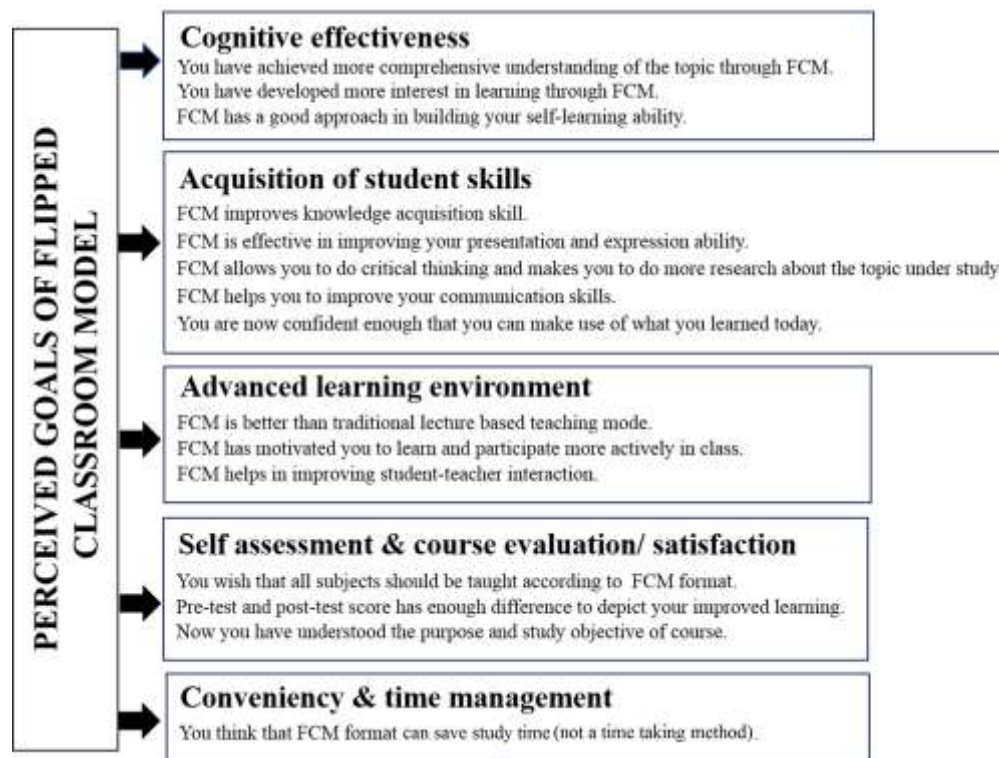


Fig. 1 FCM related perceived goals of student success skills and the figure showing questions being categorized in particular student skill.

The students review the lecture before the class at their own pace and time. According to the flipped classroom model, the role of the teacher transforms from deliverer of knowledge to guide and mentor for the students. Therefore, FCM may provide interactive educational sessions that are more beneficial and purposeful in making formative assessments, [5], [6], [7].

Recently, FCM is gaining attention and continuous attempts are also being made at Chinese universities. In China, however, cases where FCM is introduced in universities are mainly applied to Chinese students, [8], [9], [10], and have not been sufficiently applied in international student education. Most international students are adults, they have clear learning motivation and active learning consciousness. They can easily understand and accept new concepts. In addition, there has been a huge amount of achievement in the medical field in the past few decades, and it is impossible to passively learn all the knowledge from textbooks. Based on the characteristics of international students and the particularity of medical education itself, teachers should further deepen the reform of medical education, changing from knowledge transferors to curriculum developers, learning collaborators, and helpers.

Therefore, our study's primary goal is to find out whether FCM can be implemented with similar success in basic medical courses for international Bachelor of Medicine & Bachelor of Surgery (MBBS) students as in other general subject curricula in China. To achieve this goal, we developed an episode of the Biochemistry course using this model. After the class, we attempted to sort out our research questions that could help identify the perceived goals of FCM for international MBBS students. We are anticipating that our research findings will

provide the basic data for developing this novel teaching method for international students.

## II. METHODS

### A. Study Participants

The Biochemistry course is offered to both International students and Chinese students at Nanjing Medical University. The classes were of the same duration and conducted under the same tutor to ensure stable observation of the assigned task. A total of 184 students were recruited for the study in which 77 students were International students (male = 47, female = 30) while the remaining 107 were Chinese students (male = 45, female = 62) collectively ranging between the ages of 18-21 years (Table I). The curriculum consists of weekly theoretical classes for about 160 min and the lectures were delivered in the classroom in the form of presentations and video demonstrations.

TABLE I. DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

	International students	Chinese students
number	77	107
Gender	Male 47 (61.1%) Female 30 (38.9%)	Male 45 (42.1%) Female 62 (57.9%)
Age (years)	18-21	18-21

### B. Procedure

The procedure of flipped learning is as follows:

First, for pre-class study, students were required to study the content in advance independently. This material relevant to the course curriculum was prepared by the teachers and it included

presentations, content notes, video lectures, online study resources, lessons from books, and supplementary notes. The duration of the video lectures was also specified as short duration. We asked the teacher to prepare 10-15 multiple-choice questions relevant to the content already provided to the students, and 10-15 min were given to the students to complete the test.

The in-class activity involved teacher teaching about the basic concepts associated with Biochemistry. The students discussed more questions with the teacher according to their critical thinking and by doing group discussions. In the end, students submitted their brief reports summarizing what they learned during the lecture and through group discussions.

For post-class activity, the teacher already prepared a test and provided it to the students to evaluate their understanding of the concepts they learned. The teacher also checked the students' reports and provided them with feedback.

A self-administered questionnaire named FCM-perceived goals questionnaire (FCM-PGQ) was prepared using a 5-likert scale (1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree). The questionnaire including 15 questions discussing various parameters of FCM was distributed among the students. These questions were classified into five major perceived goals involving cognitive effectiveness, acquisition of student skills, advanced learning environment, self-assessment & course evaluation/satisfaction, convenience & time management (Fig. 1). The first four parts were collected to evaluate the satisfaction of FCM. International students and Chinese students were provided feedback forms separately. SPSS was used to check its reliability and its pilot study was conducted among 30 individuals where its reliability Cronbach's alpha was found to be 0.883, so, the measures demonstrated acceptable reliability.

The influence of FCM on international students' performance in class and in the end-of-semester test was also objectively quantified.

C. Data analysis

The data was collected through the FCM-PGQ. The mean value was calculated to understand the perceptions of the effect of flipped learning. t-test and Chi-square test were conducted to examine the differences in evaluation between international students and Chinese students. Scatter plots and Spearman's correlation coefficient were used to display and analyze the relationship between students' performance in class and the end-of-semester test. In all cases of analysis,  $p < 0.05$  was used to determine significance.

III. RESULTS

184 questionnaires were sent out and 184 valid questionnaires were collected on time.

As shown in Fig. 2, compared with the Chinese group, which shows a positive response is 63.83%, 74.65% of international students believe that FCM is an advanced learning method that can help them acquire collaborative skills and motivate them to learn and participate more actively in the classroom. The

average satisfaction of international students with FCM teaching is 3.973 points, which is much higher than that of Chinese students with 3.781 points ( $p < 0.05$ ).

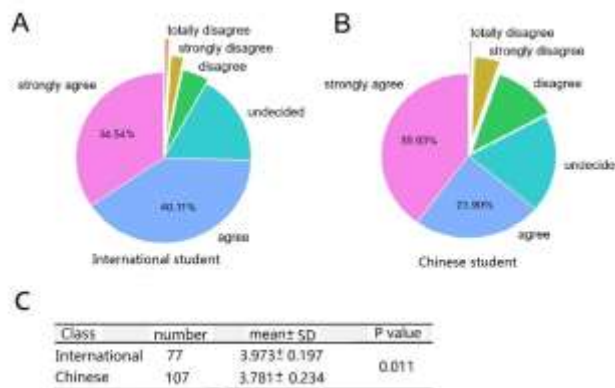


Fig. 2 The satisfaction of FCM in the international students group and Chinese students group. A: international students group, B: Chinese students group, C: Average satisfaction of international and Chinese students

The descriptive statistics for the survey are shown in Table II. The majority of the international and Chinese students felt FCM can also help in achieving the goal of improving cognitive effectiveness (mean score of 4.02 and 3.97), acquiring students' skills (mean score of 4.02 and 3.82), providing an advanced learning environment (mean score of 4.01 and 3.71). Self-assessment, course evaluation, and satisfaction are the three major parameters that students should learn to keep track of their performance. FCM again proved promising in achieving all of the above-mentioned parameters, according to students' observations (mean scores of 3.85 and 3.76).

TABLE II. THE AVERAGE SCORES OF FCM IN THE INTERNATIONAL STUDENTS GROUP AND CHINESE STUDENTS GROUP

Perceived Goals of FCM	International students			Chinese students		
	-%	+%	Mean value	-%	+%	Mean value
1 Cognitive effectiveness	6.07	78.40	4.02	12.13	70.43	3.97
2 Acquisition of student skills	8.58	76.18	4.02	17.00	63.38	3.82
3 Advanced learning environment	6.06	76.70	4.01	21.50	58.23	3.71
4 Self assessment & course evaluation/satisfaction	11.27	66.30	3.85	17.42	63.57	3.76
5 Convenience & time management*	68.90	13.00	1.14	20.50	58.80	2.63

\*  $p < 0.05$

To our interest, as shown in Table II when international and Chinese students were asked whether FCM is a time-consuming method, the groups responded just oppositely. Chinese students thought that the period taken by FCM was suitable enough to acquire knowledge and could easily followed. In contrast, international students think that FCM is a time-consuming method and it needs more time to fulfill the learning needs of students ( $p < 0.05$ ).

As we know, more international students were satisfied with and felt it easier to accept FCM than Chinese students, so it seems reasonable to believe that international students may study independently and participate more actively in class.

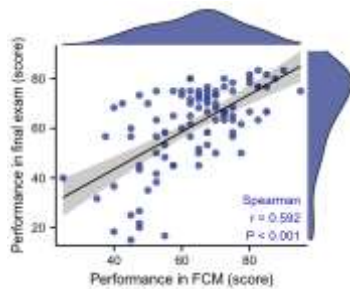


Fig. 3 Correlation Coefficients for international students' performance in FCM (total score: 100 points) and their performance in the final exam (total score: 100 points).

As shown in Fig. 3, international students ( $n = 103$ ) who tend to receive lower end-of-semester test scores had worse grades in class performance, whereas students who received higher test scores had better performance in class ( $R = 0.592, p < 0.001$ ).

#### IV. DISCUSSION

As we know, whether FCM improves the quality and efficiency of teaching largely depends on investing in classroom teaching through the teacher's preparation, the self-study attitude, and the completion ability of the students before class. Biochemistry, which includes theoretical and experimental sections, is one of the fundamental medical courses in the second year for international students in China. In line with the modern education concept that emphasizes students' dominant position and cultivates their communication and innovation abilities in teaching practice, the teachers have carefully compiled clinically representative and discussable cases in FCM. These cases include seven categories of theoretical cases (structure and function of biological macromolecules, metabolic diseases, diseases related to genetic information expression, diseases related to cell signaling transduction, gastrointestinal diseases, hepatobiliary and blood system diseases, and endocrine system diseases) and four categories of experimental cases (clinical serological diagnosis-related experiments, experiments regarding the molecular mechanism of some specific disease, comprehensive experiments with some special diseases, and basic experiments of molecular biology technology), [11]. According to the teaching syllabus, micro-class videos and virtual molecular biology experiments were also uploaded to the network platform for students to study independently.

International students in our university come from countries such as India, Thailand, and Pakistan. These countries' teaching strategies, as compared to Chinese traditional lecture-based learning, seem to create a more relaxed and interactive learning environment. Most of the international students feel unrestrained and sure of themselves in class. They are active in asking questions and have a positive classroom performance, [12]. FCM requires open thinking, critical thinking, and

teamwork, [13]. Therefore, FCM aligns more with the characteristics of MBBS international students who actively seek out and solve problems. Additionally, FCM takes into account the differences in learning ability and classroom acceptance of each foreign student, as international students come from various educational backgrounds. FCM not only allows for the leadership and organization of students with strong fundamentals and learning abilities but also provides additional space and time for students with weaker fundamentals and learning abilities. The findings here indicate that more international students felt that FCM helped them develop collaboration skills and motivated them to engage more actively in class. The majority of international students responded more positively to FCM than Chinese students.

Considering the question of whether FCM is a time-consuming method, the opinions from international and Chinese student groups responded oppositely. According to Chinese students, it is not a time-consuming method, while according to international students, there is a need to extend the period provided for completion of course content to follow FCM. This difference in opinion between the groups elucidates their attitudes toward the time required for this model. International students would have to dedicate much time to their pre-class material before attending lectures to gain a better understanding. This idea further clarifies that this group wants to extend the period for following this approach, as they have shown this willingness in previous questions.

While this method is being applied, we could observe several limitations as well. The major limitation we could see was the inconvenient time availability to follow this approach. Most of the Biochemistry class still uses lecture-based learning. Additionally, FCM has higher requirements for teachers and curriculum arrangement [14], [15]. According to the questions listed on FCM-PGQ, the teachers' explanations helped make connections between the pre-test and class lecture. However, the positive outcomes of international students were significantly lower than those of Chinese students (data not shown). Therefore, extra time is needed for the Chinese teacher to select teaching materials for international students.

#### V. CONCLUSION

International MBBS students showed more positive responses towards FCM than Chinese students in the Biochemistry class. This result may have important implications for modifying the supporting assessment mechanism and choosing the best teaching method for MBBS students in line with national conditions, to further improve teaching quality for international students in China.

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REFERENCES

- [1] Statistical report on international students in China for 2018 - Ministry of Education of the People's Republic of China. Gov. cn. Available from: [http://en.moe.gov.cn/documents/reports/201904/t20190418\\_378692.html](http://en.moe.gov.cn/documents/reports/201904/t20190418_378692.html). Cited 2023 May 2.
- [2] Top destination of international students worldwide. Statista. Available from: <https://www.statista.com/statistics/297132/top-host-destination-of-international-students-worldwide/>. Cited 2023 May 2.
- [3] Jiang Q, Horta H, Yuen M: International medical students' perspectives on factors affecting their academic success in China: a qualitative study. *BMC Med Educ* 2022, 22(1):574.
- [4] Jiang Q, Yuen M, Horta H: Coping strategies of failing international medical students in two Chinese universities: A qualitative study. *Teach Learn Med* 2023:1-11.
- [5] Chen F, Lui AM, Martinelli SM: A systematic review of the effectiveness of flipped classrooms in medical education. *Med Educ* 2017, 51(6):585-597.
- [6] Banks L, Kay R: Exploring flipped classrooms in undergraduate nursing and health science: A systematic review. *Nurse Educ Pract* 2022, 64:103417.
- [7] Sourg HAA, Satti S, Ahmed N, Ahmed ABM: Impact of flipped classroom model in increasing the achievement for medical students. *BMC Med Educ* 2023, 23(1):287.
- [8] Peng W, Xiong Y, Wei J, Chen X, Huai W, He S, Liu D, Tian X, Tang S, Chen Y: Flipped classroom improves student learning outcome in Chinese pharmacy education: A systematic review and meta-analysis. *Front Pharmacol* 2022, 13:936899.
- [9] Li S, Liao X, Burdick W, Tong K: The effectiveness of flipped classroom in health professions education in China: A systematic review. *J Med Educ Curric Dev* 2020, 7:2382120520962838.
- [10] Xu P, Chen Y, Nie W, Wang Y, Song T, Li H, Li J, Yi J, Zhao L: The effectiveness of a flipped classroom on the development of Chinese nursing students' skill competence: A systematic review and meta-analysis. *Nurse Educ Today* 2019, 80:67-77.
- [11] Liu X, Yuan L, Li Z, Chen Y: Practice of CBL + flipped classroom in biochemistry and molecular biology teaching. *Basic Medical Education* 2020, 22(10):705-707
- [12] Vangjel R, Habili M, Abazi A: The role and the impact of interactive teaching methods in increasing students' interest for the field they study (case study master of scientific marketing faculty of Economics University of tirana year 2018-2019, 2019-2020). *Int J Educ Inf Tech* 2023, 17:21-31
- [13] Nichat A, Gajbe U, Bankar NJ, Singh BR, Badge AK: Flipped classrooms in medical education: improving learning outcomes and engaging students in critical thinking skills. *Cureus* 2023, 15(11):e48199.
- [14] Pablo-Lerchundi I, Nunez-Del-Rio C, Jimenez-Rivero A, Sastre-Merino S, Miguez-Souto A, Martin-Nunez JL: Factors affecting students' perception of flipped learning over time in a teacher training program. *Heliyon* 2023, 9(11):e21318.
- [15] Terrenghi I, Diana B, Zurloni V, Rivoltella PC, Elia M, Castaner M, Camerino O, Anguera MT: episode of situated learning to enhance student engagement and promote deep learning: preliminary results in a high school classroom. *Front Psychol* 2019, 10:1415.

**Contribution of individual authors to the creation of a scientific article (ghostwriting policy)**

Jun Du, and Maria Bibi designed and implemented the research investigation. Jun Du, and Xiao Wei processed the data and wrote this study.

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**Conflict of Interest**

The authors have no conflict of interest to declare.

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