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Original Article

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Introduction of Flipped Classroom as an Innovative Teaching Learning Methodology among the Undergraduate Students in Pathology

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Abstract

Background: This study was undertaken to introduce flipped classroom as a teaching learning tool, assess the perception of students and faculty towards flipped classroom methodology. ***Methods:*** The study was conducted with 157 students and 12 faculty members. A pre-validated questionnaire was given to the students and the faculty. The data was analyzed using SPSS version 28 and expressed as frequencies and percentages. A post - test was conducted after two weeks following the session. ***Results:*** 157 students of Phase II MBBS and 12 faculty members submitted their response. 91.72 % students strongly agreed that flipped classroom promotes motivation, learning and understanding of the course material. 87.90% of students felt that flipped classroom should be followed by other subjects also in the MBBS curriculum. 92.99% of the students wanted other lesson plans to be conducted through flipped classroom. 100% students agreed that the facilitators were able to engage the students in the in-class activities. 92.35% of students opined that teachers clarified the doubts, provided feedback and assessed learning. 91.67% of the faculty was motivated to introduce flipped classroom. 100% responders believed that interaction with students in the class had increased to a great extent with this methodology. 91.67% of the faculty believe the in-class time is more utilized for higher order thinking skills. ***Conclusion:*** Flipped classroom approach has the potential to promote student centered self directed active learning, connects teacher and students and allows them to share information and promotes higher order thinking skills.

Keywords: ***Flipped classroom, methodology, self directed.***

Introduction

The working definition of the flipped classroom describes a technique where foundational knowledge is acquired independently by a learner prior to a classroom encounter, and class time is then devoted to applying new information and knowledge via discussion [1]. The traditional method of teaching in Pathology so far has been teacher oriented and focusses mainly on the knowledge domain. Graduate Medical Education Regulations -2019 (GMER-2019) signify a paradigm shift in the Indian medical education with emphasis on competency-based undergraduate curriculum. The teaching learning and assessment methods have to be aligned with the objectives. New teaching and learning techniques that have been introduced recently, one of them is flipped classroom methodology, that can allow for more classroom time to be dedicated to fostering higher-level cognitive skills, such as teamwork, critical thinking, problem-solving, research, and knowledge-building with the support and guidance of educators and peers. Here a portion of learning takes place online complemented by in-person interactions with instructors who are skilled in hands-on practical activities, in order to enhance engagement, interaction, and collaboration among participants [2,3].

Faculty should acknowledge the importance of seeking out innovative approaches to enhance the engagement and relevance of learning, and consider incorporating them with the existing technological tools to encourage students' active involvement in constructing knowledge and applying it in real-world settings [4,5]. It is imperative to seek ideas that utilize e-learning technologies as potent promoters for active self-directed deeper learning in our education systems [6].

Basic components of flipped classroom are: pedagogical principles, based on revised Bloom's taxonomy [7], planning phase includes conducting needs assessments, determining content and learning outcomes, and selecting appropriate educational and assessment methods [8]. Han and Klein drafted a list of "best

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practices" to approach pre-class learning materials for flipped classroom approaches like match the pre-class learning materials with the learning objectives, avoid duplication of material, give clear instructions for pre-class work, respect students' time constraints, incorporate assessments in pre-class materials, dedicate time at the start of class for questions and review of main ideas, ensure students come prepared for class, and make sure pre-class materials are available early [9]. Chi and Wylie categorized different modes of engagement as follows: passive involvement entails receiving knowledge, listening to a lecture, and recalling information, active engagement - manipulating knowledge, taking notes, and applying knowledge to similar contexts, constructive engagement - generating knowledge, comparing and contrasting information, and transferring knowledge or procedures and interactive engagement involves dialoguing, discussing with peers, and collaboratively creating knowledge [10]. In flipped classroom approach, students can achieve higher learning outcomes more effectively, given the increased classroom time allocated to activities that promote active, constructive, and interactive engagement modes [12].

Implementation of flipped classroom in higher education suggests a boost in student satisfaction and enhanced academic performance, evidenced by improved exam scores, pre- and post-test results, and course grades [13]. To prepare students for their up-coming challenges in their future careers, flexible and sustainable application-oriented knowledge to solve problems is of great importance [14].

Different models of blended learning and flipped classrooms have been suggested (a) The rotation model involves integrating online engagement within various in-person forms of instruction in a continuous cycle. (b) The flex model involves having multiple students primarily engaged in online learning, with a teacher physically present to oversee their progress. (c) The self-blending model involves students selecting and completing different courses independently while having a supervising teacher and fellow students present. (d) The enhanced-virtual model involves infrequently supplementing online, virtual experiences with physical co-presence to enrich the overall experience [15].

The main objective of this study is to incorporate flipped classroom teaching into the curriculum as a form of active learning and to evaluate how students and teachers perceive this teaching methodology.

Methodology

The study was initiated after the clearance from the Institutional Ethics Committee following which the faculty of the Department of Pathology and students were sensitized with flipped classroom teaching learning methodology. Study was conducted in the department of Pathology wherein 157 Phase II students were enrolled. Modules on the following topics were chosen to be prepared for II phase MBBS students. (a) Laboratory diagnosis of Microcytic hypochromic anemia. (b) Pathophysiology of different types of Shock

Type of study: cross sectional study

Study design: descriptive questionnaire based

Study population: MBBS Phase II students and teaching faculty

Selection criteria

Inclusion criteria: Students and faculty willing to give consent for the study

Exclusion criteria: Not willing to give consent for participation

Data collection procedure: a pre-validated questionnaire was given to the students and the faculty which was based on Likert scale with variables from 1-5 to analyse their perception towards flipped classroom methodology with higher scores representing higher levels of satisfaction. It was a quantitative representation of the data as: strongly disagree, disagree, neither agree or disagree, agree, strongly agree. Written informed consent was obtained from both students and faculty one month prior to the module's introduction for their participation in the study. The students were apprised about the availability of the material in the virtual mode (wats app group / email). Suggestions for reading from the textbooks and websites related to the topic was also notified so that they could access it on time and study individually/ in groups. The material provided contained videos, podcasts, power point presentations, pictures of hematology and histopathology slides, automated cell counter reports, case based scenarios, concept maps, evidence based journals and web based resources. A self-assessment activity was shared on Google Forms, consisting of multiple-choice questions as well as image identification tasks. The students were instructed to reach out to the facilitators if they needed clarification.

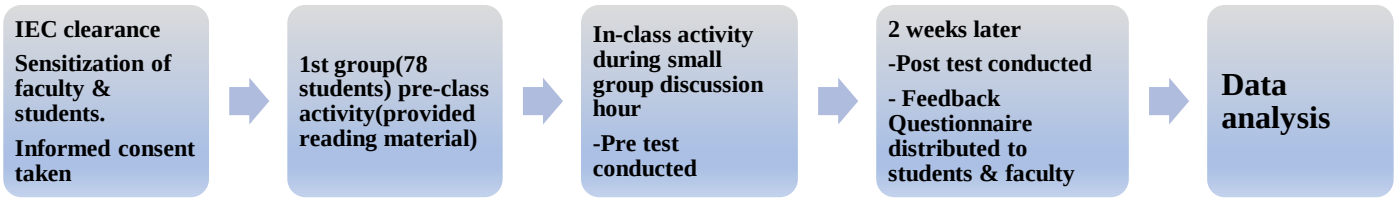
During the in-class activity, the group of 78 students was split into 5 groups, each assigned a facilitator. The facilitator's responsibilities included resolving doubts, applying critical thinking skills to clinical case studies, offering feedback, and concluding the session. Each group participated in the in-class activity, which included small group discussions, think pair and share, and brainstorming, for a duration of one and a half hours.

A pre-test was administered at the conclusion of the in-class session in the classroom, followed by a post-test conducted two weeks after implementing the flipped classroom approach, in order to evaluate retention using this method.

Questionnaire was shared with the students and faculty after the completion of both the modules for all the students.

Data analysis: The data collected from the questionnaires was analyzed using statistical software SPSS 28.0.

Ethical considerations: IEC clearance was obtained before the conduct of the study. Consent was obtained from the study population. Confidentiality of the participants will not be disclosed. Data will be used only for the intended purpose of the study.



Observations and Results

157 students of Phase II MBBS and 12 faculty members submitted their response to the feedback questionnaire (100% response rate).

Students

Among the responders, there were 49.68% (n=78) male & 50.31% (n=79) female students, with an average age of 20.92 ± 0.87 years (Range being 18-24 years; 21 years being the median age).

Based on the responses obtained, 91.72 % students strongly agreed that flipped classroom promotes motivation, learning and understanding of the course material. 84.71% students admitted that adequate time was provided for pre-classroom activity. 26.11% students felt they had to work more out of the classroom in flipped methodology. Sametime 73.89% students didn't feel they had to work more out of the classroom. 85.99% of students felt the lesson plan for the chosen topic were well organized with each activity having clear purpose. 96.81% students felt they were able to pace themselves through the course of the flipped classroom.

94.9% students felt flipped classroom have helped them in integration pathology with clinical case scenarios and they also felt pre reading material was appropriate and relevant to the topic chose. 87.90% students believe it cultivates critical and creative thinking skills. Total of 92.35% of students felt that the in-class activities were largely group based.

87.90% of students feel that flipped classroom methodology should be followed by other subjects also in the MBBS curriculum. 92.99% of the students want other lesson plan/ modules to be conducted through flipped classroom. 100% students agreed that the facilitators were able to engage the students in the in-class activities. 92.35% of students opined that teachers clarified the doubts, provided feedback and assessed learning.

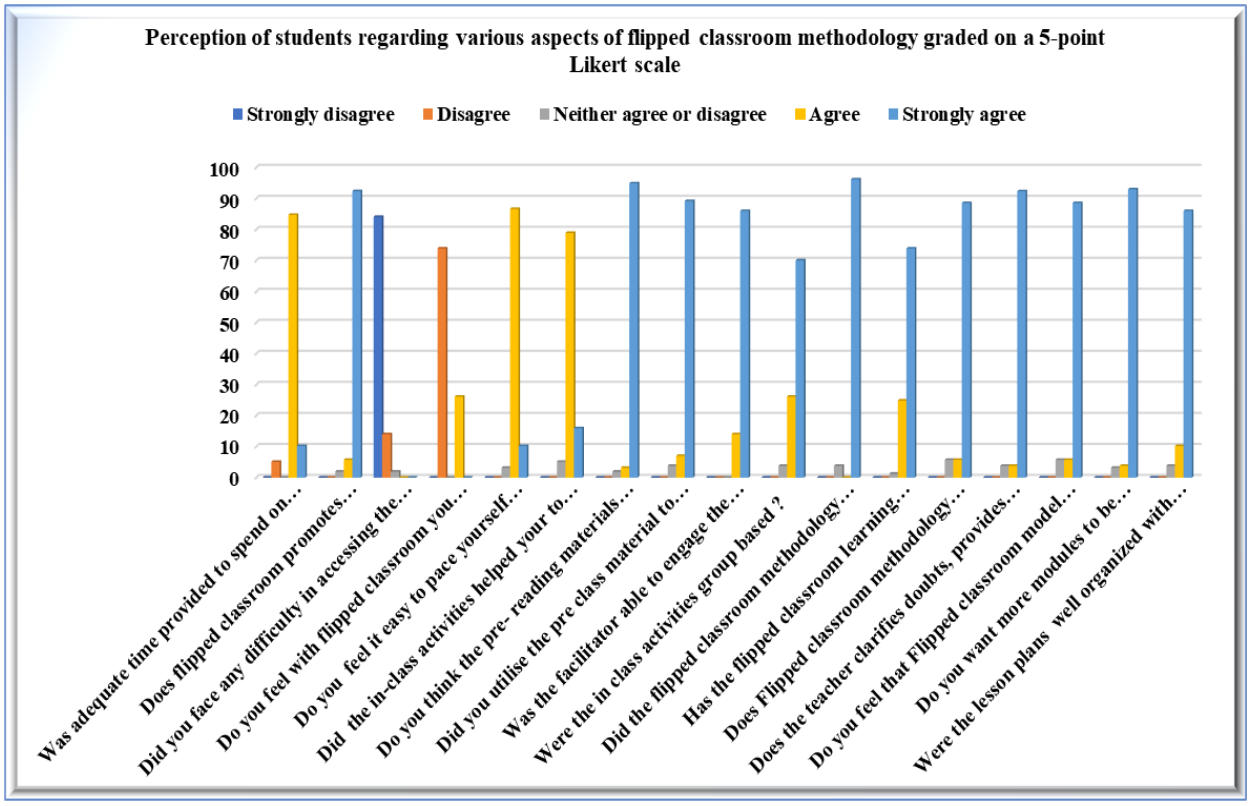


Figure 1. Graph shows Percentage of Perception of students regarding various aspects of flipped classroom methodology graded on a 5-point Likert scale.

For test of significance, *chi-square test {$|\chi^2|$ - test} and **|Z| - PROPORTION TEST

Higher percentage of MBBS students significantly agreed with the statements with p value {$p<0.05$} except third statement did not show significant with p value {$p>0.05$}.

FACULTY

Responders comprised of 3% (n=3) males & 75% (n=9) females, with a mean age of 49.77 ± 14.80 years (Range being 34-69 years).

Based on the responses obtained, 91.67% of the faculty was motivated to introduce flipped classroom methodology. 100% responders believed that interaction with students in the class had increased to a great extent with this methodology. 91.67% of the faculty believe the in-class time is more utilized for complex higher order thinking skills rather than knowledge acquisition and they also believe it is a student centric method of solving problem, increase peer to peer interactions. They also believe flipped classroom methodology is in alignment with the CBME curriculum introduced in Indian Medical Education System. 83.33% of faculty disagree on the fact that flipped classroom is time consuming. 25% of faculty found monitoring students during pre-class activity as a big challenge. 91.67% faculty strongly agrees that it is an effective tool towards formative assessment and they feel that student will emerge as a lifelong learner with the flipped classroom teaching learning methodology.

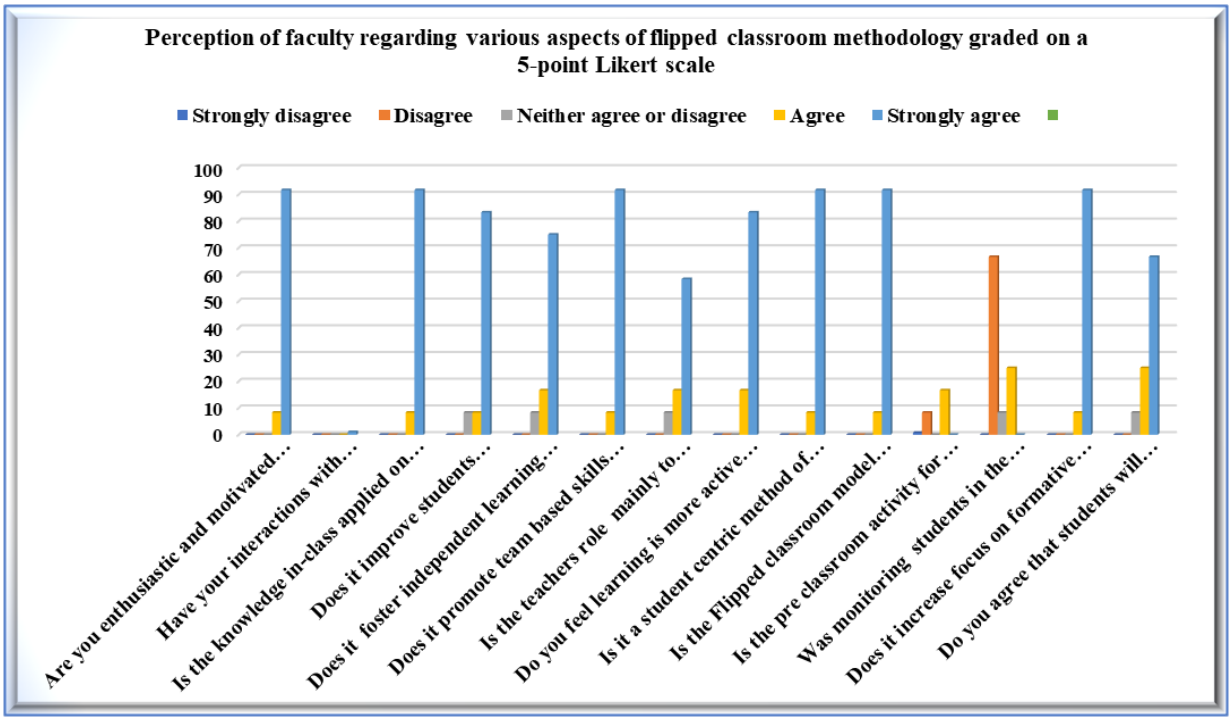


Figure 2: Graph shows Percentage of Perception of faculty regarding various aspects of flipped classroom methodology graded on a 5-point Likert scale

For test of significance, *chi - square test {$|\chi^2|$ - test} and **|z| - proportion TEST. Higher percentage of faculty members significantly agreed with statements, with p value {$p<0.05$}. except eleventh statement which was not significant with p value {$p>0.05$}

Table.1. Frequency table of the pre and post test score: below represents the scores obtained by the students in the pre and post-test.

Value/marks obtained (M.M 20)	Pre test students		Post test students		P Value	Results
	No.	Percentage	No.	Percentage		
16	43	27.39%	31	19.75%	0.0787	Not significant
17	55	30.03%	48	30.57%		
18	30	19.11%	32	20.38%		
19	24	15.29%	31	19.75%		
20	05	3.18%	15	9.55%		
Total	157	100%	157	100%		
Mean ± s.d	17.32 ± 1.58		17.69 ± 1.65		0.0433	Significant

- The mean score improved from 17.32 to 17.69 after the intervention (post-test), and this change is statistically significant (p= 0.0433), indicating a likely effect of the intervention.
- However, when comparing the distribution of students across specific score values, the difference is not statistically significant (p = 0.0787).

Discussion

In the present study, 94.90% of students felt the pre-reading material was relevant and appropriate to the competency decided for the flipped classroom.

In a study conducted by Rehana et al, 97% of students found the preparation material useful and appropriate, whereas 87% enjoyed the small group class more than the usual large class formats. Additionally, a large number of students noted that the class was enjoyable and engaging, and that they found it beneficial to collaborate in groups to solve problems [16].

In the current study, the majority of students (88.54%) believed that this approach should be adopted by other subjects in the MBBS curriculum. Additionally, 92.99% of the students in our study expressed a desire for more modules to be taught using the flipped classroom methodology. In a study conducted by Fatima SS, 75% of the class completed the preparation before coming to the assigned flipped classroom session [17]. The flipped classroom model received high recognition and 84% of the students' responded that it should be used more often and across the teaching years. Similarly, 87% said that they learned much better in flipped classroom as compared to their regular classes. A significant number of individuals believed that the pre-class materials provided for preparation improved their critical thinking skills and facilitated a stronger connection between understanding the concept and applying it [17].

According to the research conducted by Angadi NB, the flipped classroom method was perceived as more successful in achieving learning goals by the majority of students, with approval rates varying from 90% to 94%. A large number of students also reported that completing assigned worksheets before class helped them grasp the material better and that studying foundational concepts beforehand enhanced their overall learning experience. Furthermore, almost all students agreed that engaging in interactive activities during class improved their comprehension. Both students and faculty members showed enthusiasm for incorporating more flipped classroom sessions in the curriculum, with instructors recognizing the advantages of active learning and supporting the

regular utilization of such teaching approaches [12]. The current research emphasized that 85.99% of students believed that the lesson plans were effectively structured, with each activity serving a specific purpose, and 92.99% of students expressed a desire for additional modules to be arranged in future. These findings align with previous studies conducted on the topic [12,17]. 96.18% of students believed that collaborative learning was enhanced, while 87.90% perceived an improvement in critical and creative thinking skills. The flipped classroom model aimed to achieve higher levels of Bloom's taxonomy, including knowledge and comprehension through pre-class activities, and application, analysis, synthesis, and evaluation through participatory in-class activities.

83.33% of the faculty felt the method as more active and experiential learning consistent with study by Angadi et al. [12].

Sabale implemented the flipped classroom model with the goal of using class time for facilitation. The pre-class activity ensured that students had a solid understanding of the topic, allowing more time for discussions and group activities during class. This model allows for more interactive classroom sessions and promotes increased interactions between students and teachers [18]. In our study, a similar percentage of students, 94.90%, used the pre-class reading material and felt that it was suitable and applicable to the subject. Additionally, 89.17% of students utilized the material before assessments.

Fatima SS found that 77 % students were more engaged in activities in the flipped classroom model and showed enthusiasm towards formative assessment during the session. They were able to clear up their queries and misconceptions more effectively compared to traditional settings. 84% of the students suggested that it should be implemented more frequently across various teaching years [17]. Additionally, 87% stated that they learned better in the flipped classroom compared to their regular classes [19] similar to our study where it was 89.98% students felt engagement.

In Darnal HK's study, a majority of 52% out of 75 students found the clinical scenario to be helpful in recalling the pathophysiological mechanism. Additionally, 60% of the students believed that the clinical scenario aided in their comprehension of the pathophysiological mechanism and preferred it over traditional teaching methods [20].

Sabale RV, concluded in the study that all students agreed to this model which encouraged communication between the students and teacher, encouraged active participation of students, and they could learn through group activities conducted in class. Almost 85% agreed that they were well prepared for the class. Regarding disadvantage, 92% of the students felt that this model to be time consuming. From a teacher's point of view, once he/she gets expertise in making Google Form, it is not time consuming [18].

96.18% students felt flipped classroom improved collaborative learning. 94.90% students felt pre reading in-class materials were relevant and appropriate.92.35% students agreed teachers clarified doubts and provided feedback.

The findings of the study conducted by MK Suryawanshi showed that 91% of students felt that flipped classes made them participate more actively in the in-class sessions than didactic lectures, 83% students found that their interaction with fellow students and faculty increased during flipped classes. 81% students reported that it is easier to manage time with flipped classes. Access to the study material was reported to be easier by 96% of students. Flipped classes helped 91% of students in self- motivation. Also, it helped 94% of students to achieve in depth learning of the topics and 92% of students for increased overall understanding of the topic. As flipped classes facilitated overall process of learning, 90% of the students felt more satisfied with it than didactic lectures [21].

83.33% faculty felt the interaction with the students has increased during the in-class activities. improved students motivation and engagement. Flipped classroom model provides direct interaction of the students and the facilitator and helps in the alignment of the knowledge which can be put into clinical practice. 91.67% faculty felt it promoted team based skills and peer to peer interactions with good attendance in the class. 78.98% of students felt that it improved degree of integration between pathology and clinics. The flipped classroom model requires students to manage and maintain motivation for both implementing self-directed learning and enabling students to manage their own learning processes [22]. These findings are similar to the study done by Nichat A et al also mentioned that flipping classroom helps students to learn at their own pace, practice multiple revisions of the same topic, increases peer-peer interaction and the in-class time is utilised for interaction with the teachers & doubt clarifications [23].

Kasat P et al also mentioned that this teaching learning methodology has benefit in building concepts, development of critical thinking and with better long term memory retention [24].

The vast majority of facilitators concurred that the flipped classroom is superior to other interactive teaching methods. They believe it creates an ideal setting for fostering a team-based learning environment. Students also expressed a desire for more flipped classroom sessions on various topics, noting that it helps them collaborate effectively in groups [16].

It was suggested that thorough analysis of the concept and planning should take place to identify the learning outcomes and methods to reinforce learning [16].

Smith S implemented showed that trainees felt well-prepared for in-person sessions by the flipped approach, leading to increased motivation to participate in discussions with peers and tutors. They were more actively engaged and challenged to think critically during sessions, as noted by all tutors through trainee-led discussions and thoughtful questions [25].

Lecturer should be creative in designing the teaching-learning process, use any kinds of media for the outside class interaction, and share videos related to students' learning. The flipped classroom is one model that makes students more active and interactive both in the classroom and outside it. When teachers apply Flipped learning, it means that they apply active learning [26].

The study findings by Rehman R et al emphasized that learning can be facilitated in peer lead discussions by developing confidence and self-motivation for synthesis and application of knowledge [16].

The results are in accordance with literature where FCR has been reflected as a positive learning experience with students' engagement and commitment to peers, in a technology-enhanced learning environment [11].

Flipped classroom is a teaching and learning methodology that involves students engaging with course materials (such as lectures, readings, videos, etc.) on their own time outside of class, while using class time for more interactive, collaborative, and hands-on activities.

Conclusion

Flipped classroom can enhance the teaching and learning experience by promoting active engagement, fostering deeper understanding, encouraging collaboration, and providing more personalized support for students.

Declarations

Acknowledgement

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Conflict of interest

None

Source of funding

None

Ethical clearance

Letter no. AMCH/IEC/2021/12/03

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