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Flipping and Engaging: Usefulness of Case-Based Flipped Classroom in Ensuring Conceptual Learning under Competency-Based Medical Education

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ABSTRACT

The 21st century has seen tremendous evolution in the field of medical education, alongside massive use of technology for learner interaction and engagement to ensure contextual learning. Keeping in line with the global trend in medical education, the National Medical Council of India introduced Competency-Based Medical Education in 2019 for medical graduates. Competency-Based Medical Education is an outcome-based approach that focuses on the abilities that medical professionals should possess to provide medical care to the population.

It is designed to create an "Indian Medical Graduate" possessing requisite knowledge, skills, attitudes, values, and responsiveness, so that she or he may function appropriately and effectively as a physician of first contact of the community while being globally relevant.

This requires shifting the teaching-learning activities from traditional to modern innovative approaches. Active learning strategies in competency-based medical education are interactive lectures, Flipped classrooms, discussion-based, Scenario-based, problem-based, case-based, team-based, and peer teaching.

Among these, we have used Flipped classrooms with case-based exercises during class. PowerPoint presentations of the lecture and resources from the textbook were provided beforehand, with instructions to the students that they are required to read before the scheduled face-to-face class. During the class in the form of multiple choice questions, discussion was carried out for the topic which included case-based multiple choice questions, and case-based scenarios to emphasize the topic. It is observed that students of the current generation enjoy more interactive and task-based sessions.

Introduction

The National Medical Council (NMC) of India introduced Competency-Based Medical Education (CBME) in 2019 for medical graduates. It is designed to create an "Indian Medical Graduate" (IMG) who will possess the requisite knowledge, skills, attitudes, values, and responsiveness, to function appropriately and effectively as a physician of first contact with the community. The graduates must also be trained to be globally relevant so they can serve abroad[1].

Medical training has been evolving over the years of modernization and changes in the expectations of the stakeholders. The 21st-century learners, being tech savvy and with less concentration on monotonous activities, like to have novel teaching activities for effective learning. Traditional teaching in the initial days of the MBBS Course, involved highly qualified content experts teaching content in the classroom through lectures and tutorials. The current generation of medical students suffers from tremendous cognitive load and therefore criticize didactic teaching. Teachers face challenges of the short attention span of students and engaging them, through a 1-hour didactic session. Thus educators introduced newer methods of information dissemination which shifted the teaching-learning activities from traditional to modern, including more student-centered activities[2].

Competency-Based Medical Education curriculum requires active learning strategies which include discussion-based, scenario-based interactive lectures, delivered in a flipped manner. Other strategies include problem-based learning, case-based learning, team-based learning, and peer teaching.

Fatima 2017[3] reported the flipped classroom model enhances student engagement and active learning in first-year medical courses. Malhotra 2023[4] found that students generally preferred this approach because of the interactiveness of the session, even though significant performance improvement was not observed. The MBBS course as directed by NMC requires Physiology to be taught as a preclinical basic science in the first year. It has been found that basic science knowledge when learned in a clinical problem or case context has been found to be significantly useful for understanding the concept and clinical relevance of a topic[5,6,7,8].

Therefore, based on the hybrid teaching model[9] our current study incorporated flipped classroom principles with case-based exercises in class to improve learning, which were supervised and guided to ensure information accuracy and prepare first-year students to progress to the second phase of the medical curriculum. The flipped classroom strategy ensured autonomous learning by the students through guided learning materials, while the in-class case-based activities ensured knowledge application and critical thinking, using physiological theories to explain clinical phenomena[10].

The aim of the study was to introduce an innovative teaching-learning activity to promote self-directed learning and comprehension, along with effective management of information thus developing critical thinking along with problem-solving in a justifiable manner.

Material and Methods:

The study, approved by the Institutional Ethics Committee (IEC) was conducted on 150 first-year undergraduate medical students in an NMC-recognized private medical college in Gujarat. All students were informed of the method and purpose of the study beforehand. This was a routine teaching-learning activity to satisfy student-centric learning as directed by NMC, hence we received a waiver of written consent.

The topic of "Mechanism and Regulation of Secretion of Hydrochloric Acid from Stomach" chosen was from the "core content" in Physiology of Gastrointestinal System. A flipped lesson on the "Mechanism of Hydrochloric acid (HCl) secretion in the stomach" was prepared, including the already stated learning outcomes with appropriate

cognitive verbs of Bloom's Taxonomy. The resources were provided as PowerPoint presentations (PPTs) of 36 slides and relevant textbook chapters through a designated WhatsApp group. Students were instructed to read the content provided and come prepared for the class, which was scheduled on the timetable one week later. It was informed that during class multiple choice questions (MCQs) on the topic will be asked which they will have to attempt individually. Following that, discussions will be conducted further to be supported by case-based questions.

IN CLASS ACTIVITY:

On the day of the scheduled class, students assembled in the classroom and were seated group-wise. Ten (10) MCQs which included two case-based were projected one by one via the PowerPoint and the possibility of each of the responses being the correct answer, was discussed by randomly asking the students.

After the MCQs were conducted, students answered five short answer questions which were discussed in the class. This was done to enhance writing skills and promote the students' reasoning ability in answering the critical thinking questions.

Finally, a real-life case of 'peptic ulcer' was provided to reason out the pathophysiological basis of signs and symptoms and debate amongst themselves to arrive at the correct answer. Twenty minutes were provided for discussion within the group. The discussion included the physiological basis of signs and symptoms, reasons for the investigations, interpretation of investigation reports, and physiological basis of treatment. Each group discussed amongst themselves and eventually, there was a wrap-up with the facilitator clarifying doubts and misconceptions.

Table 1 shows the variety of question samples used.

Table 1: Examples of In-class activities

MCQs	Which cells of the Gastric mucosa secrete Hydrochloric acid? a. Parietal cells b. Chief cells c. G cells d. Enterochromaffin-like cells • A 35-year-old obese female presents with a chief complaint of non radiating epigastric abdominal pain and nausea. Her social history is significant for moderate alcohol use, excessive caffeine intake, and smoking one pack of cigarettes daily. Her medical history reveals that she has been taking nonsteroidal anti-inflammatory drugs (NSAIDs) for the past 3 months for a knee sprain. She also keeps a large supply of antacid tablets (histamine receptor blockers) at her bedside. She wears a hormone-releasing patch to avoid pregnancy. The abundance of independent disease risk factors from her history lead to an initial diagnosis of gastroesophageal reflux disease. The mechanism of which of the following risk factors is correctly described? A. Antacid tablets, since hypochlorhydria may worsen acid reflux B. Being obese, since a high body mass index lowers intragastric pressure C. Contraceptive patch, since progestins weaken lower esophageal sphincter tone D. Nicotine and caffeine, since they stiffen lower esophageal sphincter muscles E. NSAIDs, since they cause dizziness so that patients frequently lie down
SAQs	Atrophic gastritis leads to Megaloblastic anemia. Give reason.
Case scenario	• Mr. Kaushik, a 45-year-old male, a software engineer in a multinational company was suffering from indigestion and periodic abdominal pain for last 3 months. • The pain was occurring in the upper abdomen, daily 2 hours after lunch and dinner. Pain was burning in nature which improved after taking antacid medications. It was occasionally associated with vomiting. • He was a chronic smoker and gave a history of eating outside food more frequently. He reported less duration of sleep for few days in a week due to work. • On examination, vital signs were normal. Tenderness was present in the epigastric region. The general and rest of the abdomen examination was normal. • The physician referred him to a gastroenterologist for fiberoptic endoscopy (FE). The findings of FE showed an ulcer in the duodenal bulb. Gastroenterologist further confirmed the diagnosis by taking a biopsy showing H. Pylori growth. • He was treated with antibiotics and omeprazole.

The feedback was collected from the students on a Google Form, using a Likert scale. The pre-validated questionnaire had items on perceptions of flipped lessons. The faculties of the same department validated the questionnaire and a few faculties of other departments in the institute followed by a pilot test of a questionnaire on a few students, who became volunteers to validate the feedback. The questionnaire, which is attached as a supplementary file, included questions like whether the session was enjoyable, whether helped in understanding a particular topic, whether problems were relevant in the context of the important and common diseases, etc. The questionnaire also gave the students opportunity to comment on the enhancement of self-directed learning, exchange of ideas in group discussion, during sessions tutor guidance, correlating clinical conditions to basic mechanisms, understanding of a particular system and associated clinical conditions etc.

Post-session, retention of information was tested by giving one case-based question (CBQ) of five marks on the same topic in the second internal examination, which was held 15 days after the class. The marks obtained in the test reflected the performance of the students. Standardization of marking was ensured through a model answer with a scoring rubric.

Data Analysis

The feedback form was analyzed through Excel analysis as it was obtained through the Google form. The students' responses were analyzed by descriptive statistics, using percentages and finding out themes through content analysis of extended comments by the students. The performance of the class was recorded through the marks obtained in the CBQ.

Results:

Feedback received on the Likert scale from students on flipped lessons. A total of 148 students who attended class provided their written feedback on the flipped lesson. Students expressed gross acceptability of such sessions indicating that it make learning enjoyable and contextual. More than 70% of students reported that it promoted their self-directed learning and ability to exchange ideas with peers.

The details of the responses are represented in **Figure 1**.

Figure 1: Student's Feedback on Flipped lesson

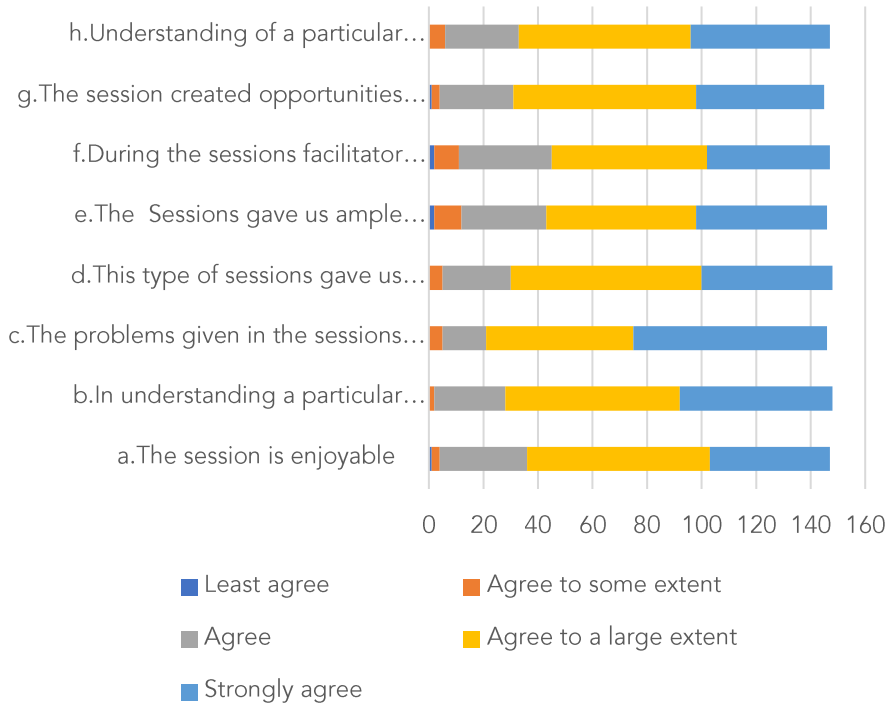

Table 2 shows the marks obtained in case-based questions during the second internal examination. 54% of students passed. The passing criteria is scoring 50% marks which 2.5 out of 5.

Table 2: Students' scores in Case-based question on Peptic ulcer

Marks (out of 5)	Total number of students	Percentage
< 2.5	69	46
≥ 2.5	81	54

Discussion:

The didactic lectures often turn out to be monotonous and less engaging even though they are preferred on account of the fact that they ensure uniform dissemination of information to all students in the class. This traditional teacher-oriented approach, where the majority of class time is devoted to the teacher's delivery of knowledge, tends to result in little interaction between teachers and students, as the latter often engage with the material in a passive manner[11,12].

The flipped classroom paradigm is becoming increasingly significant in the context of CBME. In a flipped classroom, students work on learning materials before class, using video lectures or books, and then use the class time for interactive activities, discussions, and problem-solving[13]. The flipped classroom switches the emphasis from passive lecture-based learning to active, learner-centered participation[14,1,10] This is consistent with the CBME concept, which emphasizes competency development and knowledge application in clinical practice[15].

Moving information dissemination outside of the classroom allows class time to be spent on activities that promote knowledge application and integration[16]. This enables more individualized feedback, coaching, and targeted support for learners to acquire the needed competencies[17]. The flipped classroom paradigm enables students to take responsibility for their learning, which promotes the development of self-directed learning abilities[18]. This is critical in CBME since learners are required to constantly evaluate their strengths, limitations, and learning requirements to steer their professional development[19]. This supports satisfactorily achieving the learning outcomes as students get an opportunity to learn at their own pace and further clarify their doubts with the facilitator in the classroom[20].

The availability of pre-class learning materials in a variety of formats (e.g., videos, texts, podcasts) caters to diverse learning styles and allows students to interact with the information in a way that best matches their requirements[17]. This can improve student engagement and facilitate the achievement of competencies in a more inclusive manner. The flipped classroom style makes it easier to administer formative evaluations and provide timely feedback, both of which are important aspects of CBME. Learners can receive feedback on their comprehension and application of concepts during in-class activities, allowing them to discover areas for growth and change their learning tactics accordingly[18].

To summarize, the flipped classroom method is consistent with CBME principles by emphasizing learner-centered education, efficient use of class time, self-directed learning, and formative evaluation[21]. The flipped classroom paradigm can help with the successful adoption of CBME in medical education.

To make the flipped classroom more engaging and to elicit critical thinking skills, case based exercises were introduced in the study. Case-based learning (CBL) is a cornerstone of CBME in which students learn by working through problems and therefore apply their knowledge and skills to real-life medical cases. CBL allows the development of critical skills in medical practice, such as patient review, data

reading, and diagnosis with justifiable treatment choices[22]. Additionally, CBL facilitates integration of basic sciences with clinical disciplines by engaging students in detailed clinical cases, thereby aiding critical understanding of medical concepts. Such conversations are almost always more engaging for learners than ordinary didactic lectures because they actively engage the students in learning and make them understand how the subject matter relates to their future practice[22,2].

Case-based learning also allows educators to assess students' clinical reasoning, judgment, and problem-solving skills, all of which are important outcomes of CBME[23], [22]. It can provide a foundation for students to structure their knowledge base by presenting them with many different clinical scenarios and, in turn helping develop an identity as a professional and developing the beliefs, attitudes, and behaviors they will need when practicing medicine[24].

In our study, we combined flipped classroom principles with case-based exercises in class to improve learning, which were supervised and guided. Since this class was conducted for novice first-year medical students it was necessary to do some hand-holding to guide them through the process. This ensured the accuracy of the information gathered, managed, and learned. In order to prepare first-year students to progress to the second phase of the medical curriculum, this served as a successful method. The majority of students agreed that not only was the flipped lesson session enjoyable, it was also effective in understanding the topic and provided opportunities for self-directed learning (SDL). They also appreciated the exchange of ideas which helped them link clinical conditions with basic mechanisms.

This prompted an understanding of a specific system and its associated clinical conditions. Directed by facilitators at every point they required was an additional positive point since they did not feel confused or demotivated.

Our study is well corroborated by the study by Adrian Leis. 2018[25] and Cai L[26] reported that implementing a case-based flipped classroom in the context of competency-based medical education (CBME) improved student engagement and conceptual learning. Our study also proved that using flipped learning strategies, resulted in improved understanding and preparation, as students study information at home and participate in classroom activities. This is in line with the observations of a study by Roux[27] who found that this strategy leads to higher academic accomplishment and pleasure, by facilitating deep learning and the application in real-world circumstances. However, Jump[28] (2013) discovered that, while students reported a strong sense of personal progress, they were dissatisfied with the course delivery, which did not appear in our study, except for a very few numbers of students who stated that they were not so satisfied with this self-directed learning strategy. This implies that while the case-based flipped classroom is useful for conceptual learning, there may still be room for improvement in its implementation.

Conclusion:

The two different educational strategies of a flipped classroom and case-based learning with contextual modifications can be justifiably used together to impart conceptual information to students, ensuring critical thinking, decision-making, problem-solving, self-directed learning, collaboration, and communication skills, in first-year medical students, all of which are necessary for developing 21st century competencies for progressing to the next level of education.

Conflict of Interest:

The authors declare no conflict of interest.

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