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## Students' Feedback on Effectiveness of Combined Flipped Classroom and High Fidelity Simulated Teaching on Airway and Ventilation During Accident and Emergency Posting

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### ABSTRACT

Simulation-based medical education enables knowledge, skills and attitudes to be taught in a safe, realistic manner. Flipped classroom teaching encourages self-learning. Emergency medicine exposes students to diverse group of patients and physicians' decision making. This study aims to determine students' perception on knowledge, skills and confidence after combined flipped classroom and simulated teaching. Two cohorts of Semester 7 students Group 1 (n = 120) and Group 2 (n = 78) completed a 5-point Likert scale questionnaire. Group 1 completed the questionnaire after a lapse of six months while Group 2 at the end the posting. Responses from both cohorts were compared using the Mann-Whitney U test. Of 198 (Groups 1 and 2) students, 91.41% (n = 181) felt the simulated sessions helped better understand care of emergency patients. The sessions helped identify knowledge gaps (89.90%; n = 178), improve knowledge and understanding of oxygen therapy devices (85.35%; n = 169), and airway equipment (90.91%; n = 180). They prepared better for the flipped classroom teaching than traditional sessions (80.81%; n = 160). They felt that their communication skills (82.32%; n = 163) and confidence (63.64%; n = 126) improved. Significant differences noted to questions ( $p = 0.006$ ,  $p = 0.005$ ,  $p = 0.041$  respectively) targeting knowledge on oxygen therapy devices, confidence, and identification of gaps in knowledge respectively. Combined simulation and flipped classroom teaching was well received by students though this requires more preparation.

**Keywords:** *Flipped classroom, Simulation, Feedback, Teaching style*

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## INTRODUCTION

Simulation-based medical education enables knowledge, skills, and attitudes to be taught in a safe, focused, and targeted manner and simulation becomes a powerful learning tool when learning outcomes are clearly defined (1). Procedural skills, communication, leadership, and team work can be learnt in the simulation lab and be transferable to workplace by students and practitioners. Simulation can help students identify gaps in their learning, and motivate them to learn more. These are key factors in promoting self-directed, life-long learning (2, 3). The “flipped” part of the flipped classroom means that students watch or listen to lessons at home and do their “homework” in class (4).

Accident and Emergency (A&E) posting is one where students are exposed to a diverse group of patients, most of them being acutely ill. Students tend to not pay attention to details like the flowmeter on the wall behind the patient’s bed or the flow of oxygen being delivered with the various oxygen therapy devices. We believed that some basic knowledge on oxygen therapy and airway management is required for students to understand the decisions made by physicians when managing the wide range of patients presenting at the A&E unit, especially the acutely ill patients. Traditionally, in the clinical skills unit, the lecturer introduces various oxygen therapy devices and demonstrates the techniques of use to the students. This is a teacher centered teaching style with very little student input. The effectiveness of this session depends on the pro-activeness of individual students in the groups, their group dynamics and their state of preparation prior to coming for the class. Many come to the class with no prior reading as was noted by lecturers during the teaching sessions.

We decided to change the teaching style of the airway and ventilation sessions from the more didactic and teacher controlled session to a student centered session by conducting

a flipped classroom session followed by high fidelity simulated teaching. All students were encouraged to give a feedback on the teaching and learning by completing a questionnaire.

## OBJECTIVES

1. To determine the response to the flipped classroom and high fidelity simulated teaching among Semester 7 (Year 4) students during their A&E posting.
2. To determine if there is any difference in response between two cohort of students when one cohort was given the questionnaire after a lapse of six months (one semester).

## METHODOLOGY

This is a descriptive cross sectional study conducted on two cohorts of Semester 7 (Year 4) students after flipped classroom and simulated teaching as the teaching style. All students in the A&E posting were included in the study. Total number of students who participated in this study was 198 (Groups 1 and 2). All students, during their A&E posting are expected to attend two sessions on airway management and ventilation with the anaesthetists where they are taught about the basic airway equipment, technique of use, and airway management.

Normally each group posted for the sessions consist of 9–10 students. Traditionally, in the clinical skills unit, the lecturer introduces various oxygen therapy devices and demonstrates the techniques of use to the students.

### The New Revised Teaching Process

1. Video recording of the correct technique of application of the airway adjuncts, oxygen therapy devices (bag valve mask, laryngeal mask airway), and intubation with ventilation were uploaded onto the e-learning portal.

2. Links to the manual for cardio-pulmonary resuscitation (prepared by the faculty) was provided on the e-learning portal.
3. A detailed online instruction on learning objectives and the content (types of oxygen therapy devices; nasal prong, simple face mask, reservoir mask, and the airway equipment; oropharyngeal airway, naso-pharyngeal airway, laryngeal mask airway [LMA]), and endotracheal tube) was provided for students to prepare prior to the sessions.
4. Students were advised to read up on common cases seen in A&E like acute exacerbation of asthma/chronic obstructive pulmonary disease, acute coronary syndrome, anaphylaxis, and trauma.
5. The students go through the flipped classroom session on the first week of the posting.
6. Students experience managing common acute medical emergency cases with simulated session using high fidelity manikin on the second week.

### ***Flipped classroom session***

Each student is given a device and expected to talk to the rest of the class about the device and its function followed by the demonstration of its use on a part-task trainer. The lecturer will observe and contribute to the learning by also adding information and demonstrating if there is a need. Students will not know which device will be given to them. Therefore, they are needed to prepare for all the devices identified in the online instruction.

### ***Simulated teaching session***

High fidelity manikin was used to conduct these sessions, simulating common medical emergencies that present to A&E. Prior to starting the session, students were introduced to the manikin and briefed

about the objectives and expected learning outcomes of the session. They were divided into two groups of five and each group is given a scenario. During each of the session, one group watched the other perform from another venue. At the end of both sessions, a debriefing session was held where students commented on each other's performance, self-assessed, as well as had the lecturer provide a feedback. Actions were queried, myths were cleared, and questions were asked.

Feedback on the teaching activity was obtained from the students using a questionnaire with a 5-point Likert scale; 1 = strongly disagree, 2 = agree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree (APPENDIX).

## **DATA ANALYSIS**

As we found that data was not normally distributed, a statistical analysis using the Mann-Whitney U test was carried out. We did not apply for ethical clearance as this was a part of our routine teaching only with a different teaching style.

## **RESULTS**

Two cohorts of Semester 7 students Group 1 (n = 120) and Group 2 (n = 78) who went through the new teaching delivery during their A&E posting completed the questionnaire. Their responses were combined and analysed together. Of the total 198 (Groups 1 and 2) students who participated, 91.41% (n = 181) (agree and strongly agree) of students felt that the simulated sessions helped them understand A&E and care of emergency patients better while 89.90% (n = 178) felt that the simulated sessions helped them identify gaps in their knowledge. Students felt that they had better knowledge of the oxygen therapy devices (85.35%; n = 169), and felt they understood the airway equipment better after these sessions (90.91%; n = 180). They prepared better for the flipped classroom

teaching than they would for the traditional sessions (80.81%; n = 160). They felt there was improvement in communication skills when working as a team (82.32%; n = 163). There was a significant number (88.89%; n = 176) who felt there should be a regular simulated sessions in all postings and confidence was perceived as improved (63.64%; n = 126) (refer Figure 1).

Difference in response was noted between the two cohorts to Questions 1, 3 and 4 ( $p = 0.006$ ,  $p = 0.005$ ,  $p = 0.041$  respectively) which targeted knowledge on oxygen therapy devices, improvement in confidence, and identification of gaps in knowledge by students after the sessions respectively (refer Table 1).

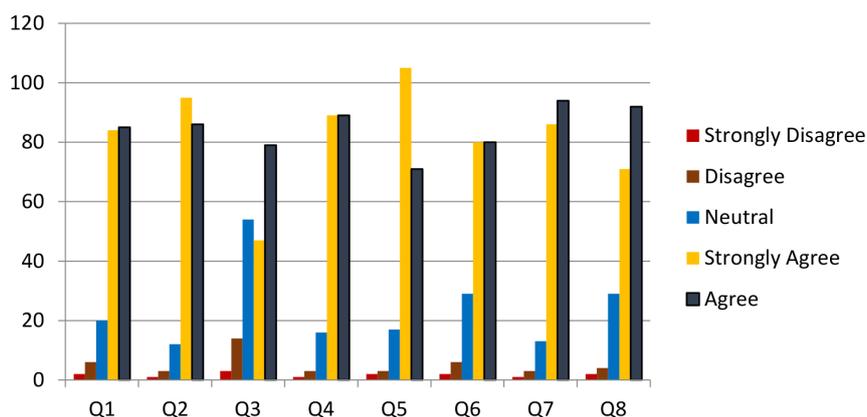


Figure 1: The combined responses by both the cohorts of students (n = 198).

Table 1: Comparison of Groups 1 and 2 students on their responses to the questionnaire

| Question | Students | Mean rank | Sig. (2-tailed test) | Mann-Whitney U | Z      |
|----------|----------|-----------|----------------------|----------------|--------|
| 1        | Group 1  | 91.18     | 0.006                | 3682.000       | -2.763 |
|          | Group 2  | 112.29    |                      |                |        |
| 2        | Group 1  | 93.78     | 0.053                | 3993.000       | -1.937 |
|          | Group 2  | 108.31    |                      |                |        |
| 3        | Group 1  | 90.79     | 0.005                | 3635.000       | -2.794 |
|          | Group 2  | 112.90    |                      |                |        |
| 4        | Group 1  | 93.43     | 0.041                | 3951.500       | -2.041 |
|          | Group 2  | 108.84    |                      |                |        |
| 5        | Group 1  | 99.55     | 0.986                | 4674.000       | -0.017 |
|          | Group 2  | 99.42     |                      |                |        |
| 6        | Group 1  | 101.14    | 0.590                | 4483.000       | -0.538 |
|          | Group 2  | 96.97     |                      |                |        |
| 7        | Group 1  | 95.22     | 0.147                | 4166.000       | -1.452 |
|          | Group 2  | 106.09    |                      |                |        |
| 8        | Group 1  | 95.45     | 0.181                | 4194.000       | -1.339 |
|          | Group 2  | 105.73    |                      |                |        |

## DISCUSSION

The overall response from the students was good with most acknowledging the usefulness of both (flipped classroom and simulated) the teaching sessions. From a practical point of view the introduction of this method of delivery in the teaching curriculum is time consuming needing greater effort from the teacher as well as the students.

The main focus of a flipped classroom centres on the delivery of print, audio or video based material prior to a lecture or class session. The class session is then dedicated to more active learning processes with application of knowledge through problem solving or case based scenarios. The rationale behind this approach is that teachers can spend their face-to-face time supporting students in deeper learning processes (5). This was the main reason for the change in our teaching style as we found that many students were not prepared and had no knowledge about the basic oxygen therapy devices and airway equipment, let alone when to use these equipment. Flipping the classroom made them prepare for class as the ball was in their court, they had to present and demonstrate.

Literature search did not come up with studies on outcomes of combining flipped classroom and simulation specifically though there were many on the benefits of each as a teaching style (1, 2, 4, 5). We used high fidelity simulation to increase the realism and give students more hands on experience as part of the teaching activity post – flipping. Research on simulated teaching shows that medical simulations are educationally effective, and complement teaching and learning in the real setting (6).

There has been a gradual change in the way learning take place due to declining access to patients, shift in patient care towards outpatient management, and difficulty in finding the suitable patient for bedside teaching (7). Students in Semester 7

(Year 4) are still relatively new to assessment and management of acutely ill patients, including trauma patients. Introduction to the basics of the equipment was followed by their use in a simulated environment to enhance students' experiential learning and this was very well received by the students as evidenced by their feedback (Table 2).

**Table 2:** Qualitative feed-back by students

- |     |   |
|-----|---|
| 1.  | Student-orientated sessions would only be beneficial if everyone have prepared.   |
| 2.  | More sessions will be useful.   |
| 3.  | Good session, well structured (10/10).  |
| 4.  | I found the session highly useful. It is the best way to teach topics under A&E.  |
| 5.  | The simulated sessions are beneficial for active learning and provided a platform for us to experience a close to real life situation.      |
| 6.  | More frequent flipped classroom should be arranged, provided there are lecturers who prefer a flipped rather than the traditional teaching. |
| 7.  | I wish to have more regular simulated sessions at least in every semester.  |
| 8.  | More simulated session.   |
| 9.  | More simulations for better experience and understanding.   |
| 10. | Awesome learning experience.  |

A lot of commitment is required to achieve good learning outcomes but there is evidence that learners rate simulated teaching highly (8, 9, 10). In simulated emergencies, post-training scores indicate significant improvement in skills (9).

Simulation training can increase students' confidence but this does not equate to competence (11, 12). Confidence is also difficult to measure, being and maybe related to an individual's personality and even gender (13, 14). In our study, we found that there was a significant difference in confidence levels after a six month period which could also be attributed to the fact that students may not have similar exposure during subsequent postings thus affecting retention of skills and knowledge.

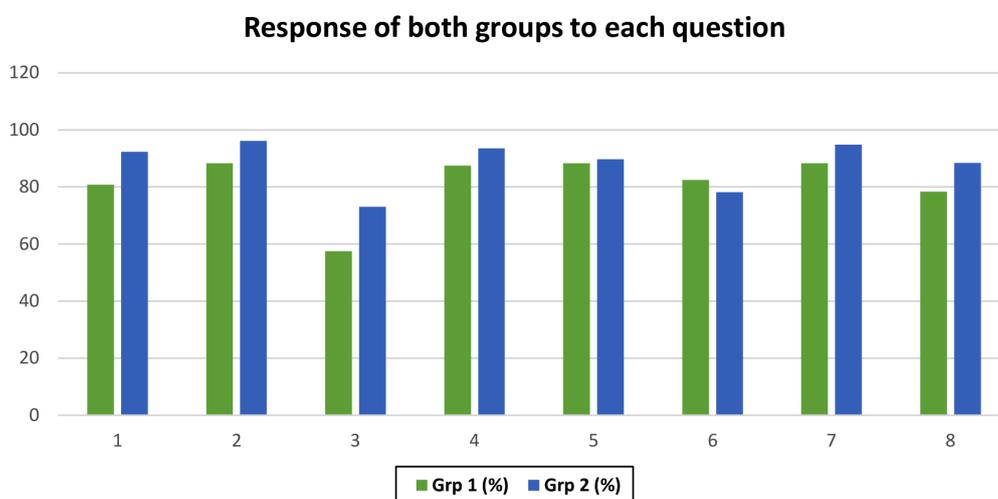
We found that the group responded to the questionnaire after a six month time interval scored poorly on confidence and knowledge. Students tend to learn in a compartmentalised manner, sometimes by posting, semester, professor, or discipline and so they don't even think to bring that knowledge, "putting away for later" when they move from posting to posting. For instance while in A&E posting, when a session is with an anaesthetist, they tend to spend more time looking at issues of the airway and breathing rather than the patient as whole who could actually be bleeding beneath the blankets from a fracture femur.

The flipped classroom is a relatively new pedagogical method, which employs asynchronous video lectures and practice problems as homework, and active, group-based problem solving activities in the classroom (15). Students would access brief (~10 minutes) online videos to learn new concepts on their own time. The content could be viewed by the students as many times as necessary to master the knowledge in preparation for classroom time facilitated by expert faculty leading dynamic, interactive sessions where students can apply their newly mastered knowledge (16). The students in our research went through similar learning, viewing uploaded videos and manuals prior to coming for the timetabled classes.

Students could be included in the planning of these sessions so that they understand the value of such a session. Ways to improve student participation like a pre- flip teaching session briefing, where objectives, instructions regarding learning outcomes and expectations are made clear helped to ensure that all students were involved in the class. The fact that they are privy to the learning contents and are able to prepare in advance adds to the confidence and involvement in class, even for the usually shy and introverts. We found that flipping the classroom had a number of potential benefits, like increased educator–student interaction, more student participation, even the quiet ones, as noted in other studies; the session must be planned and implemented carefully to support effective learning (17, 18).

It appears from the students' feedback in our study that they realise the importance of being prepared for the classes to be able to maximally benefit. They found the sessions stimulating and enjoyable albeit stressful and even suggested that we have more of such sessions (refer Table 2 and Figure 2).

Teachers are always looking for ways to impart motivation, more effective learning and most of all one that would instill self-motivation and guide self-directed learning, as those who graduate ultimately



**Figure 2:** Comparing the response (agree and strongly agree) of both the groups to each of the question.

will benefit if they continue with the process of self-directed learning initiated in the undergraduate period. The results from a scoping review by O'Flaherty & Philips indicate that there is much indirect evidence emerging of improved academic performance, and student and staff satisfaction with the flipped approach (19).

Though there were studies showing benefits of flipped classroom and simulation as teaching style, we were unable to find any that used both styles structured to target a teaching activity (1, 2, 4, 8). Combinations of teaching styles like ours may help to address different learning styles and contribute to lifelong learning (20). Simulation based teaching introduced with increasing levels of complexity from early semesters could prepare students to face real situations and patients (21).

## CONCLUSION

The new teaching style combining simulation and flipped classroom teaching was well received by students though there was more work in terms preparation before classes. Further research into effectiveness of the techniques is required in terms of student performance in the examination but more importantly the awareness about management of patients in an A&E setting. The study also appears to indicate that whatever the technique used to deliver the teaching, there will be the element of decay with time lapse and in our case it appears to be in confidence and knowledge. This goes to reinforce the need for a more regular repeat of these sessions to ensure that decay is minimised and skills are maintained.

## Limitation

1. The feedback was obtained at the end of the semester for each batch. So, those who attended the posting in the beginning may have a different opinion due to the lapse in time, especially in terms of confidence in using these

devices as many may not have continued to practice using them.

2. Individual student enthusiasm, capability and personality may affect their perception of this type of teaching and learning. The more reserved and shy student may not be happy to demonstrate in front of the whole class while the more extrovert or flamboyant student would enjoy the session.

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## APPENDIX

**Students' feedback on effectiveness of simulated teaching on airway and ventilation during A&E posting. Please read the statements and kindly tick (√) in the relevant box.**

| No | Comments  | Strongly disagree (1) | Disagree (2) | Neither agree nor disagree (3) | Agree (4) | Strongly agree (5) |
|----|---|-----------------------|--------------|--------------------------------|-----------|--------------------|
| 1  | I have a better knowledge of the oxygen therapy devices now (nasal prongs, HFM, SFM etc.)                   |                       |              |                                |           |                    |
| 2  | The simulated sessions have helped me to understand the A&E and care of emergency patients better           |                       |              |                                |           |                    |
| 3  | I feel more confident after the simulated sessions  |                       |              |                                |           |                    |
| 4  | The simulated sessions help me identify the gaps in my knowledge  |                       |              |                                |           |                    |
| 5  | There should be regular simulated session in all postings   |                       |              |                                |           |                    |
| 6  | The flipped classroom teaching made me prepare for the session better than a traditional classroom teaching |                       |              |                                |           |                    |
| 7  | I understand the airway equipment better after this session (ETT, LMA, laryngoscope, etc.)                  |                       |              |                                |           |                    |
| 8  | The sessions helped me improve my communication skills when working in a team environment                   |                       |              |                                |           |                    |

**\*Flipped classroom teaching** – short video lectures viewed by students at home before the class session and while in-class time is devoted to demonstrations, discussions and question and answers.

**\*Traditional classroom teaching** – students come to class (may or often may not have prepared) and listens to the lecture by the teacher

### Additional Comments:

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