



Research Paper

Medical students' perception and attitudes on operating theatre learning experience in Sri Lanka[☆]

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ABSTRACT

Objective: The operating room is a unique learning experience that has visual, aural, kinesthetic learning stimuli and provides benefits to the medical students such as development of sound clinical knowledge and skills, and gaining personal insight into ones' career choice. However, this can be a challenging place due to the unfamiliar learning environment. We aimed to study the Sri Lankan Medical students' perception and attitudes on operating theatre learning experience.

Design and setting: A descriptive cross-sectional survey was carried out among medical students undergoing surgical clinical training on the perspectives of the teaching and learning experience in the operating theatre in Sri Lanka.

Participants: Our study group consisted of 390 medical students from four different medical faculties in Sri Lanka representing all levels of surgical clinical rotations.

Results: A majority of the students had actively participated in the operating theater. Despite this, the students' clarity of the learning outcomes and expectations in a theatre varied greatly. Majority of the students felt that the surgeons were willingly to teach but also noted that there was no standardization in teaching. This study clearly shows a significant correlation between positive emotions and surgical teams welcoming attitude towards the medical students. Long standing hours were considered a negative emotion by a majority of students. We also observed that theatre environment can be physically and mentally exhausting.

Conclusions: Thus, empathy, feeling welcome and giving breaks to refresh can go a long way in making the learning experience better. Regular feedback to trainers on students' perception of the theatre experience is important to value the students' opinion and improve the quality of the surgical theatre. We strongly recommend initiation of clear induction sessions with introduction of well-structured teaching learning activities in the operating theatre.

Introduction

Educational environments in which learning takes place, play a crucial role in the quality of the learning experience. Furthermore, they are frequently perceived by trainees to be presenting both constructive

and dysfunctional challenges which can directly be linked to academic achievement and learning [1].

A significant amount of research has been carried out exploring different aspects of the learning environment, which includes the physical, psychological, social and educational domains. These are

[☆] ACGME competencies: Patient care and procedural skills, Medical knowledge, Interpersonal and communication skills, Professionalism, Practice based learning and improvement.

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thought to play a vital role in the professional and moral development of the students. A learning environment should ideally address all these areas and also present an encouraging atmosphere with constructive feedback. A good learning environment will help in nurturing competent healthcare professionals and influence how, why and what they learn [2].

National undergraduate curriculum in surgery by Royal college of surgeons of England identifies that all students should have some exposure to the operating theatre [3]. The operating room can be described as a unique learning environment in which the learning process is molded by many facets such as the staff (surgeon, anesthetist, nurses, students, and other trainees), the operative suites, patients and complexity of the operations. Thus, operating theatre is a best example of a learning environment that has visual, aural, kinesthetic learning stimuli all in one place [4]. Moreover, operating theatre learning experience provide many benefits to the medical students such as development of sound clinical knowledge, acquisition of surgical skills, understanding the function of an operating theatre, experience the operative surgical culture and gaining personal insight into ones' career choice [5].

At the same time, operating theatre education can be a challenging place for the medical students due to the unfamiliar learning environment and in balancing learning and social relations in operating theatre. Several studies have been performed to assess the students' attitudes on the experience at the operating theatre [6]. Common negative themes identified in these studies are feeling intimidated, unwelcome, or ignored by staff, unrealistic expectations of knowledge, and inadequate learning experiences. One study states that medical students find the operating theatre a confronting, unpredictable and disorientating place for a student to learn within [7]. These obstacles identified were remarkably reproducible and there was a general consensus that the learning process in the operating theatre largely remains opportunistic, unstructured and dependent on individual trainers [8].

Due to this, strategies have been proposed to maintain a standardized learning process and enhance the operating theatre learning experience. The BID model is one such method. According to this model, the trainer will have a focused teaching-learning interaction with the students at three points. Firstly, during briefing, the trainer discusses the surgical technique planned and sets a learning goal for the surgery. Secondly, intraoperative teaching to fulfill the learning goals would take place. At the end, the trainer should conduct a debriefing with the learner about the encounter and promote reflection. The BID model has been shown to provide a teaching method that practicing surgeons can easily adopt without interference of the busy theatre schedule [9].

Most of the literature on operating theatre learning experience are concentrated in the developed western world. There is a paucity of literature on in depth analysis of the medical students' perception on the operating theatre teaching learning experience in developing countries.

Our hypothesis was that there may be areas of sub optimal learning experience that can be identified and improved. Thus, the objective of this study was to assess the perception among medical students regarding the educational environment in the operating theatre, identify variables that affect learning with the goal to improve the educational experiences of our students in Sri Lanka.

Currently, there are eight fully fledged state medical universities around the country in Sri Lanka, which award the MBBS degree. The clinical rotations are generally commenced in the clinical phase that spans from 3rd to 5th year. It is during this period that medical students attend surgical rotations in tertiary care teaching hospitals and attend the operating theatre. Generally, the medical students will attend two to three surgical clinical rotations each spanning for 4 weeks, followed by the professional surgical rotation for 8 weeks.

This study aims to describe the medical students' perspectives of the teaching and learning experience in the operating theatre among the Sri Lankan medical undergraduates. Furthermore, the benefits and challenges of the teaching and learning experience in the operating theatre

among the Sri Lankan medical undergraduates were studied.

Material and methods

A descriptive cross-sectional survey was carried out. This study was approved by the Ethical Review Committee of the Colombo South Teaching Hospital and approval was obtained from the relevant surgical departments.

Participants

All medical students undergoing surgical clinical training in the selected four medical faculties based on convenience sampling were considered for inclusion in the study and were contacted by email through the individual department of surgeries of the respective faculties. Participants received an information sheet that explained the study and what their participation would include. The study was anonymous, and confidentiality was assured.

Data collection

An online based self-administered questionnaire was given to the participants. The first part of the questionnaire was related to socio-demographic information such as age, gender, level of surgical training and 1st MBBS (end of first year assessment) results. The second part was based on the mini-STEEM 14- questionnaire designed to assess the operating room educational environment [10,11]. The mini-STEEM (Mini Surgical Theatre Educational Environment Measure) is a 14-item questionnaire to ascertain perceptions of operating theatre learning environment of medical students. It evaluates the operating theatre learning experience under three main sub headings. Namely, the surgical operating experience, friendly atmosphere in theatre and discrimination. Studies have shown mini-STEEM to be a reliable, valid and practical tool for measuring the surgical operating educational environment in undergraduate medical education [10,11]. A 5-point Likert scale with 1–5 coding was used as follows: Strongly agree (5), Agree (4), Unsure (3), Disagree (2), and strongly disagree (1). The third part of the questionnaire included the students' perception on the negative and positive effects of the learning environment and the practice of the BID model in the theatre setting [12].

The fourth part included an area for comment or free text to allow students express freely on their teaching and theatre experiences [13]. The data collection tool was pre- tested and modified accordingly. This was piloted among local faculty staff to receive feedback and further improve the question items.

Data analysis

Statistical tests were performed using SPSS statistical software. Baseline characteristics were reported as absolute numbers and percentages for categorical variables and mean and range for continuous variables. Pearson chi square was used for comparison of categorical variables; whilst continuous variables were compared using unpaired (two sample) *t*-test. Statistical significance was assumed for *P*-values <0.05.

Results

A total of 390 out of 1600 medical students participated in the study from four different medical faculties across Sri Lanka. The students' age ranged from 21 to 28 years (median age: 24 years). The students represented different levels of surgical training and different sociocultural backgrounds (Table 1).

The 1st to 3rd surgical rotations consisted of 4 week appointments whereas the final surgical rotation consisted of an 8-week rotation.

Table 1
Sociodemographic details of students participated in the study.

		Number	Percentage
Gender	Female	227	58.2 %
	Male	158	40.5 %
	Prefer not to say	05	1.3 %
Last surgical rotation	1st year	104	26.7 %
	2nd year	95	24.3 %
	3rd year	32	8.2 %
	Professorial /Final	159	40.7 %
Ethnicity	Sinhalese	326	83.5 %
	Tamil	40	10.2 %
	Muslim	19	4.8 %
	Other	05	1.2 %
Religion	Buddhist	311	79.7 %
	Hindu	37	9.4 %
	Islam	18	4.6 %
	Christian	15	3.8 %
	Atheist	08	2.0 %

Operating theatre exposure

In all appointments, students have had a minimum of one day per week of exposure in operating theatre with >4 h per session. The majority of the medical students (83.3 %, n = 325) felt that regular attendance in theatre was a necessary part of the undergraduate curriculum (Table 2).

Preparedness for operating theatre learning experience

The majority of the students (n = 279, 71.5 %) have participated in theatre induction sessions. However, 46.2 % (n = 180) of the students did not have a clear understanding of what they should know and learn in theatre. This was noted especially in the initial rotations. The medical students attending the final year rotation had better scores on the understanding of their role in the theatre (67 %).

There is also a lack of student preparedness in the early appointments. An improvement was noted in the final year rotation with 92.4 % students demonstrating clear progress is self-preparedness. Few students commented that instructions on how they should prepare for theatre was not standardized, instead this was dependent on the individual surgeons (Table 3).

Practical learning experience in operating theatre

The students have been exposed to scrubbing, assisting, and suturing in all appointments with varying frequency. The results clearly show more practical exposure in the final rotation.

Around 66.2 % of students commented on the lack of visibility of the operation. Under the comments, poor visibility in theatre was considered detrimental to learning and gaining little from attending the theatre session (6.2 % n = 24). Only 35.3 % (n = 138) of students were satisfied with the assisting opportunities (Table 4).

Mini STEEM evaluation

The radar plot demonstrates the relationship between student responses and targeted satisfactory values on the mini STEEM survey.

Table 2
Operating theatre exposure of students participated in the study.

Surgical rotation	Days per week (mean and SD)	Hours per session (mean and SD)
1st	1.65 ± 1.04	4.05 ± 0.66
2nd	1.80 ± 2.43	4.04 ± 1.08
3rd	1.82 ± 0.86	4.19 ± 0.74
Final	1.77 ± -1.04	5.33 ± 2.32

Table 3
Preparedness for operating theatre learning experience among the participated students.

Topics	1st rotation n = 104	2nd rotation n = 95	3rd rotation n = 32	Final rotation n = 159	Total n = 390
An induction session about the theatre learning is conducted before the surgical appointment*	82 79 %	63 66 %	15 47 %	119 75 %	279 72 %
Clear learning goals and objectives were given to me on what to learn*	34 33 %	51 54 %	15 47 %	112 70 %	212 54 %
I have a clear understanding on what I should know and learn in theatre*	45 43 %	52 55 %	16 50 %	107 67 %	210 54 %
Self-preparedness					
I prepare to theatre by taking histories and examination of patients awaiting surgery*	34 33 %	74 78 %	26 81 %	147 92 %	281 72 %
I prepare to theatre by reading up on expected knowledge*	28 27 %	62 65 %	11 34 %	72 45 %	173 44 %

* Strongly agree and agree statements were taken as satisfactory answers.

Table 4
Practical learning experience in operating theatre among the participated students.

Topic	1st rotation	2nd rotation	3rd rotation	Final rotation	Total
How many times have you scrubbed in theatre during last appointment? (mean and SD)	1.34 ± 1.78 n = 103	1.34 ± 2.25 n = 95	2.43 ± 2.47 n = 28	4.28 ± 3.58 n = 163	389
How many times have you assisted in theatre during last appointment? (mean and SD)	0.75 ± 1.39 n = 103	0.73 ± 1.02 n = 95	1.68 ± 1.70 n = 28	3.71 ± 3.00 n = 163	389
How many times have you sutured in theatre during last appointment? (mean and SD)	0.10 ± 0.33 n = 102	0.14 ± 0.43 n = 95	1.18 ± 1.44 n = 28	1.80 ± 2.10 n = 163	388
I was able to clearly visualize much and most of the operation during the last appointment* (N and %)	51 49 %	24 25.2 %	11 34 %	86 54.0 %	172 44.1 %
I got enough opportunity to assist in the last appointment* (N and %)	19 18.2 %	24 25.2 %	4 12.5 %	101 63.5 %	138 35.3 %

* Strongly agree and agree statements were taken as satisfactory answers.

Values are on a Likert scale and score ≥ 4 indicates a satisfactory mean score. Overall our study showed a satisfactory mean in all parameters (Fig. 1).

Mini STEEM evaluation under sub headings

The results were further analyzed under three main headings. Namely, good surgical experience, friendly atmosphere in theatre and discrimination. Overall, 88 % had a good surgical experience and 94 %

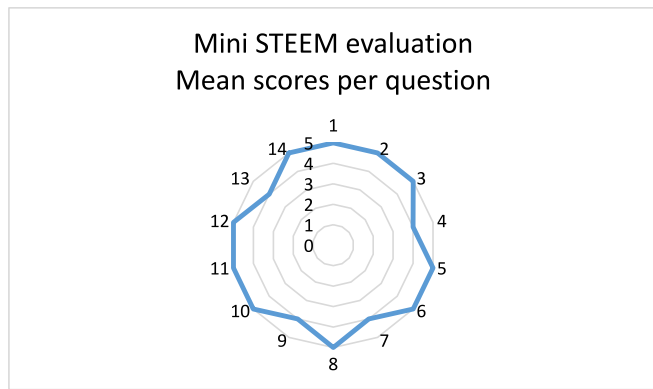


Fig. 1. Radar plot showing the mean of Mini STEEM evaluation.

considered theatre atmosphere to be friendly (strongly agree and agree statements were taken as satisfactory answers). Discrimination was felt for race and gender at very low percentages. Further analysis was not done on discrimination due to very low numbers (Fig. 2).

Trainees experience with the trainer/surgeon and the surgical team

Majority of the students felt that the surgeons welcomed them in theatre (n = 257, 66 %) and were willing to teach (n = 310, 79 %). Less number felt that the surgical team benefitted by their presence (33 %) (Table 5).

Challenges in the operating theatre

Violation of theatre protocol (n = 142, 36.4 %) and standing for long hours (n = 200, 51.2 %) were the commonest challenges faced by the medical students.

Positive and negative emotions experienced in theatre

Majority had enjoyed the theatre experience (n = 282, 72.3 %). The commonest negative emotion was feeling like a burden in theatre (n = 88, 22.5 %). There is also a significant correlation with the work hours

Table 5

Trainees experience with the trainer/surgeon and the surgical team.

Topics	1st rotation n = 104	2nd rotation n = 95	3rd rotation n = 32	Final rotation n = 159	Total n = 390
My trainer was enthusiastic about teaching*	82 79 %	67 70.5 %	21 67 %	130 81.7 %	310 79 %
I was made to feel welcome by the surgeons and the team in theatre*	71 68.2 %	61 64 %	17 53 %	108 68 %	257 66 %
I was feeling as part of the team*	46 44 %	34 36 %	12 38 %	98 62 %	190 49 %
I felt the surgical team benefitted from the medical student's presence*	31 30 %	25 26 %	08 25 %	63 40 %	127 33 %

* Strongly agree and agree statements were taken as satisfactory answers.

Table 6

Challenges in the operating theatre as felt by the students participated in the study.

Topics	1st rotation n = 104	2nd rotation n = 95	3rd rotation n = 32	Final rotation n = 159	Total n = 390
Feeling of fear and intimidation and syncope*	10 9.6 %	10 11 %	4 13 %	12 7.5 %	36 9.2 %
Violating theatre protocol due lack of knowledge with regard to "theatre etiquette," inadvertent contamination of a sterile object*	15 14 %	42 44 %	12 38 %	73 46 %	142 36 %
Confusion in theatre – where to stand, when to talk*	12 11.5 %	32 34 %	05 16 %	23 14.4 %	72 18 %
I felt tired standing for long hours*	55 53 %	49 52 %	18 56 %	78 49 %	200 51 %

* Strongly agree and agree statements were taken as satisfactory answers.

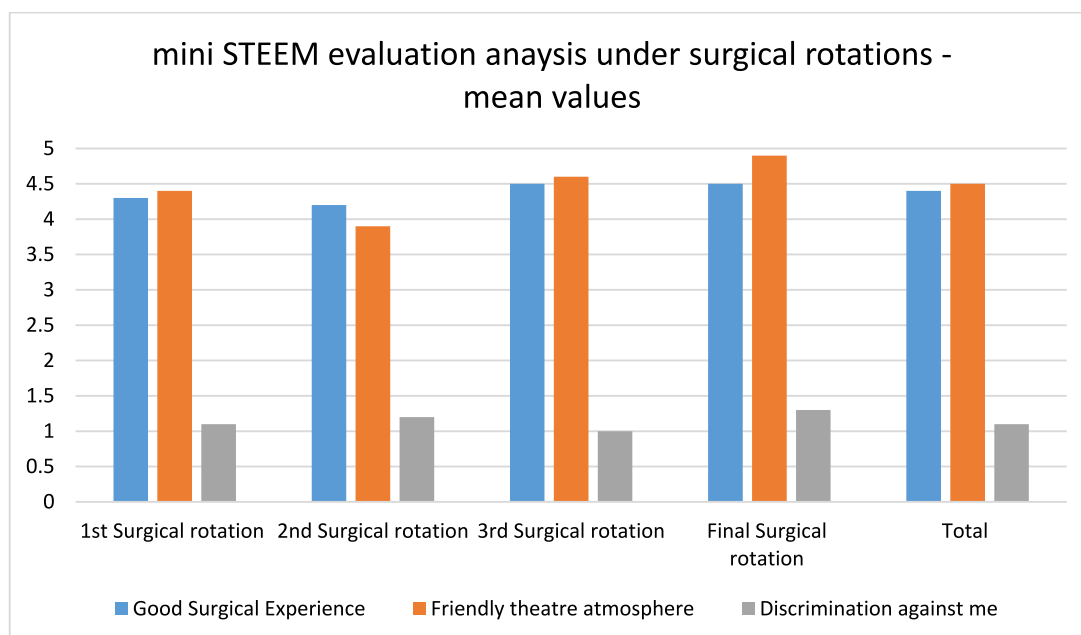


Fig. 2. Mini STEEM evaluation based on surgical rotations.

and tiredness in standing and negative emotions. ($p < 0.01$) (Table 7).

Students' experience of the BID model

Less than half the students have had a structured form of teaching. Around 98 % ($n = 382$) of students rated that a structured form of teaching would benefit the theatre learning experience (Table 8).

Students' perception about the appropriate case mix

Around 56 % and 46 % students felt they had the right operative cases in elective and emergency theaters respectively (Table 9).

Discussion

This study is one of the largest studies conducted to assess the experience and perception of medical students on operating theatre learning experience. Similar studies have been presented in the past but either they have had less participants ($n = 57-292$) or were capturing a single surgical rotation from a single institution [14–16]. Our study group consisted of 390 medical students from four different medical faculties in Sri Lanka representing all levels of surgical clinical rotations.

In our study, a majority of the students attended the operating theatre once a week for a mean duration of 4 h. There are no studies or guidelines regarding the appropriate hours/ level of operating theatre exposure for the medical students. Around 85 % ($n = 332$) of students in the study felt they had adequate exposure to theatre and among them, the mean hour was also 4 h.

A majority of the students had participated in an induction session on operating theatre learning experience. Despite this, the students' clarity of the learning outcomes and expectations in the theatre varied greatly. Similar observations have been noted in studies done in the past which reflects the static nature of this problem. For example, Ravindra and colleagues found only 47 % respondents “knew what was expected of them” in theatre [17].

Our study is unique as we have analyzed the findings based on the level of the surgical rotation. We noted that the lack of clarity regarding the learning goals was considerably seen in the initial surgical rotations. Lack of clear guidance during the initial years of surgical exposure may

Table 7

Positive and negative emotions experienced in theatre as perceived by the students.

Topic	1st rotation n = 104	2nd rotation n = 95	3rd rotation n = 32	Final rotation n = 159	Total n = 390
Positive emotions					
I enjoyed being in the theatre*	74	63	21	124	282
	71 %	66 %	66 %	78 %	72 %
The atmosphere in theatre is pleasant*	42	28	18	103	191
	40 %	29 %	56 %	65 %	49 %
Theatre experience will stimulate students interested in pursuing a surgical career*	84	70	18	112	284
	81 %	74 %	56 %	70 %	73 %
Negative emotions					
I felt like a burden and nuisance in the theatre*	21	29	7	31	88
	20 %	31 %	22 %	19 %	23 %
I felt wastage of time standing in theatre in comparison to the educational experience gained*	13	23	5	31	72
	13 %	24 %	16 %	19 %	18 %
I felt a hostile environment*	18	17	8	41	84
	17 %	18 %	25 %	26 %	22 %

* Strongly agree and agree statements were taken as satisfactory answers.

Table 8

Students' experience of the BID model.

Topic	1st rotation n = 104	2nd rotation n = 95	3rd rotation n = 32	Final rotation n = 159	Total rotation n = 390
Briefing - Before the operation my trainer discusses the surgical technique planned*	45	37	11	73	166
	43 %	39 %	34 %	46 %	43 %
Intra-operative teaching*	37	31	09	67	184
	36 %	33 %	28 %	42 %	37 %
Debriefing*	25	16	07	46	94
	24 %	17 %	22 %	29 %	24 %

* Strongly agree and agree statements were taken as satisfactory answers.

Table 9

Students' perception about the appropriate case mix.

	1st rotation n = 104	2nd rotation n = 95	3rd rotation n = 32	Final rotation n = 159	Total n = 390
Elective*	51	48	16	103	218
	49 %	51 %	50 %	65 %	56 %
Emergency /casualty theatre*	39	42	12	87	180
	38 %	44 %	38 %	55 %	46 %

* Strongly agree and agree statements were taken as satisfactory answers.

lead to poor learning interest and outcomes. Furthermore, this may discourage students from actively participating in surgical theatre rotation. Having specific learning goals for each surgical rotation was suggested to be more beneficial. These findings clearly showed that medical students require better guidance to understand the aim of theatre sessions and to correctly utilize the learning experience. We recommend that the learning outcomes stated in the undergraduate surgical curriculum should be properly and clearly communicated to students to mitigate this issue.

Literature has shown that student preparedness improves the quality of the learning activity and therefore, we assessed the student preparedness for the operating theatre learning sessions [18].

Although a majority were prepared with regard to clinical assessment of patients, less than half (44 %) had actually read up on the expected knowledge. A reason for this observation may be that students are not familiar with the appropriate learning material. It would be worthwhile highlighting the importance of self-preparedness and suggesting resource material during induction sessions.

It is encouraging to note that many medical students felt that the surgeons were willingly to teach. However, around 78 % felt the surgeons/teachers were not clear about the learning goals and there was no standardization of teaching. This is expected as surgical trainers generally teach both undergraduate and postgraduate trainees with differing standards of learning. This highlights the importance of clearly communicating with the surgical trainers regarding the faculty's expectations and expected learning outcomes for medical students. This would ensure uniformity in the teaching experience of the students. As noted in previous studies, we also observed a significant correlation with surgeons' willingness to teach and enthusiasm with positive emotions experienced during theatre [8,19].

In our study, the majority of the students had an opportunity to actively participate in the theatre which is commendable. The practical learning experience in operating theatre was considered enjoyable by 95 % and students' comments which suggested that many were eager to attend theatre to get the practical exposure. This is particularly encouraging at a time when online simulation learning is becoming popular. Students stated that learning to scrub, donning gloves and

observing the anatomy during surgery were the most important learning experiences. They preferred active participation rather than observation. Similar observation was made in other studies where medical students desired more hands-on participation and a greater focus on learning technical skills [14].

The mini STEEM evaluation revealed satisfactory scores for good surgical experience and friendly atmosphere in theatre [11]. To the authors knowledge this is one of the first studies that has described the theatre experience using mini STEEM questionnaire. We also analyzed the challenges that medical students faced when in the operating theatre. Fear of intimidation and syncope stood out in our study but at 9.2 %, as opposed to other studies that show around 42 % had actually felt pre syncope [20,21].

Violating theatre protocol due lack of knowledge with regard to “theatre etiquette,” was a huge concern among the first year students. We observed a gradual decline of these fears with advancing surgical rotations. This is one of the first studies to observe and describe the gradual decline in the fear among medical students (Table 6). This highlights the importance of trainers being more empathetic and in guiding students on theatre orientation and etiquette awareness especially during the initial rotations. In 2007, Fernando et al. recommended that the pre-teaching of theatre skills and etiquette is likely to improve the student learning experience [13]. Another study has shown similar results that a theatre etiquette course, in comparison with previous teaching methods, increases student confidence and perceived knowledge in theatre etiquette. It prepares students and reduces anxiety in subsequent theatre visits. This is likely to be a useful concept that should be discussed and recommended at the local setting especially for the early rotations [22].

Our study clearly showed a significant correlation between positive emotions and surgical teams' welcoming attitude towards the medical students. It is also important to highlight that long standing hours were considered a negative emotion by a majority of students. It is important to discuss these issues with the trainers so that they are properly addressed.

There is a growing body of literature that indicates the role of a structured learning process within the operating room. The introduction of both surgeons and students to clear, practical and achievable learning outcomes per surgical rotation and establishing interactive sessions between the students and the teachers would lead to effective learning experiences [23]. This has not been studied in our country. Therefore, we assessed the adherence to the BID model concept in our setting. Our study demonstrated a poor adherence to the BID model and teaching has mainly been non uniform. All students recorded that a standard method like BID would greatly benefit them as well as surgeons. This will also avoid unrealistic expectations of theatre-based learning by the surgeons. This is a relatively new concept that we have studied in the local setting and it is timely to introduce a structured teaching and learning process in the local setting.

Through this study, we observe that clear learning goals pitched at the level of undergraduates, familiarization with the theatre environment and etiquette and above all, approachability of theatre staff is likely to improve the learning experience.

Recommendations

Surgical operative experience is an important component as recognized by the medical students that should continue to be in the curriculum. We strongly recommend to educate both surgeons and students on clear learning outcomes for each surgical rotation. Theatre environment can be physically and mentally exhausting. Thus empathy, acknowledgment, feeling welcome and giving breaks to refresh can go a long way in making the learning experience better. Regular feedback to trainers on students' perception on the theatre experience is important to value the students' opinion and improve the quality of the surgical theatre. We propose the use of objective and structured learning goals

such as the BID model in order to improve the medical student learning experience in the operating theatre.

A practical approach to implement these changes would be to disseminate and discuss the findings of this study at the curriculum revision meetings and quality assurance cells of the medical faculties in Sri Lanka. This platform will enable us to effectively implement these changes to the curriculum. Next, approaching the College of Surgeons in Sri Lanka, which is the apex academic body for all surgeons in Sri Lanka would create more awareness about our findings among surgical trainers. Furthermore, a feedback from the trainers on their perception on theatre learning experience would provide further insight into improving the theatre learning experience for the medical students.

Limitations

The response rate in our study population was around 24.3 %. This is likely because the participants were invited via the online platform. This may have led to the differing sample sizes in the surgical rotations and related biases.

Conclusion

Medical students learning experience in the operating theatre is unique and is multifactorial.

To our knowledge, this study has the largest study sample with different levels of surgical rotations and is the first study in the Sri Lankan background. The majority of the medical students felt that regular attendance in theatre is a necessary part of the undergraduate curriculum and stresses more on the quality of the time spent than the quantity. Our main recommendation is initiation of clear induction sessions with introduction of well-structured teaching learning activities in the operating theatre.

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Ethical approval

Ethical approval was obtained from the Ethical review committee of Colombo South Teaching Hospital. (Application No: 1101).

CRedit authorship contribution statement

Kanchana Wijesinghe: Conceptualization, Methodology, Formal Analysis, Investigation, Resources, Writing original draft, Supervision.

Shashini Lunuwila: Conceptualization, Methodology, Investigation, Resources, Writing original draft.

Hasangi Gamage: Conceptualization, Formal Analysis, Resources, Writing original draft.

Thushan Gooneratne: Methodology, Investigation, Review and editing.

BNL Munasinghe: Investigation, Review and editing.

Shanmugaraj Harikrishanth: Methodology, Investigation.

Malith Nandasena: Conceptualization, Investigation, Resources.

Nilushika Perera: Formal Analysis, Review and editing.

Umesh Jayarajah: Conceptualization, Methodology, Formal Analysis, Review and editing.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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