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Enriching Operating Room Based Student Learning Experience: How Should We Structure It?

Nida Maryam, Zaitoon Zafar, Hassan Hafeez, Talat Waseem

IMPORTANCE The Operating Room (OR) is a high-pressure setting where multiple complex educational, and administrative facets interplay. The learning process, dictated by the operation list, is disparate, opportunistic, unstandardized, and at times suboptimal. Upon reviewing existing published literature regarding the learning experience in the OR setting, it was clear that this field is, to this day, unstructured and ambiguous, with many grey areas that need to be worked on. To achieve an optimized and enhanced theatre experience, it is of immense importance to recognize the pros and cons of available models that can be employed within this setting and deduce ways to improvise them into a most beneficial method. This study aims to recognize the role of a structured learning process for medical graduates in the setting of the OR. The study also explores pertinent questions; whether the learning models currently being used for residents are appropriate for medical graduates and how must we structure learning activities within OR settings.

METHODOLOGY The study involved an extensive literature review and thematic analysis to generate themes and subthemes, which were subjected to a modified Delphi technique where residents and teachers participated to identify debate and produce a consensus on the relative importance of each method when employed in Operation Theater based learning.

RESULTS While structured learning is essentially goal-oriented, student-friendly, and time-saving and provides qualitative outcomes, it, however, has drawbacks owing to a lack of faculty and resources. Various potential problems in the implementation of a structured learning process were identified and components in making the structured learning meaningful were formulated. The models each have their potential advantages and disadvantages when implemented in the OR for learning.

CONCLUSIONS Structured learning process within the OR setting should at least cover the minimum standards that a graduate essentially requires. It should be a balanced program according to the specialty. However, the quality of evidence to substantiate these aspects remains contextual with low external validity and generalizability.

KEYWORDS Operating Room; Operation Theater; Learning; Student; Simulation Lab; Surgical Education, Learning Models, OMP, Lyon's Model, Koen's Model, 4C/ID,

HOW TO CITE Maryam N, Zafar Z, Hafeez H, Waseem T. Enriching Operating Room Based Student Learning Experience: How should we structure it? *Archives of Surgical Research*. 2022, 3 (1):12-26. https://doi.org/10.48111/2022.01.03.

Original Research Communication

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https://doi.org/10.48111/2022.01.03

The role of a structured learning process for the medical graduate in the OR setting has been debated for years. As much as structured learning is appreciated, it comes with its problems. This study explores the merits of structured training, in comparison to traditional opportunistic learning. While structured learning is essentially goal-oriented, student-friendly, time-saving, and provides qualitative outcomes, it, however, has drawbacks owing to a lack of faculty and resources, time, and training, in addition to the unavailability of OR and surgical cases. A structured approach should at least cover the minimum standards that a graduate essentially requires. It should be a

balanced program according to the specialty. This study allowed participants to give their valuable input as to how we can structure learning activities within the OR.

Another critical question is whether the OR-based learning process should be standardized or opportunistic? Lyon's model and many others encourage students to apply self-regulated learning to maximize their learning experience in the OR (Lyon 2004a; Weinberg et al. 2015). However, this approach may lead to an unstandardized, opportunistic, and random learning process for medical graduates producing non-uniform student learning and healthcare safety issues. On the contrary, Roberts et al. (2009) emphasize a more structured approach towards OR-based learning.

This study further explores the potential role of various models currently being used for the training of surgical residents in OR-based learning of a medical student. Are the models currently being used for the residents learning appropriate for the medical graduates as well? The prevalent models of OR-based learning were studied in-depth and were critically appraised for their utility in the arena of medical graduates OR-based learning.

Another very important aspect of this study included the idea of synchronization of OR-based learning with simulated lab activities and the use of technology in this aspect. It is no secret that within a few years technology will dominate most of the OR activities. The need of training the faculty for the structured OR-based learning programs was also identified.

METHODOLOGY

Following ethical approval from the local institutional review, a board study was conducted between April to June 2020, consisting of two phases, which have been summarized in a flowchart in Figure 1.

In Phase 1, following the PRISMA flow chart (Figure 2), a literature search was done through Pub Med, ERIC, and Google Scholar. Thematic analysis and review were performed to analyze various models and their relevance in Operation Theater-based learning.

In Phase 2, Modified Delphi was used for analyzing the relative importance of identified models from the literature review. Modified Delphi Technique is a composite of qualitative and quantitative methodology and is especially useful in discovering the meaning that people give to events they experience (Bogdan&Biklen, 2007). Based on the Phase 1 literature review items, a Delphi questionnaire was developed for Round 1 for both students and teachers. The Delphi technique involved both qualitative and quantitative components. The quantitative component sought the participants' opinions on a Likert scale for measuring the relative value of the factors influencing students' OR-based learning. The quantitative component is appropriate for prioritizing the factors, and the Delphi approach itself was useful for consensus building. While taking a sample, a purposive sampling technique was used because of the specific nature of the research question (Fraenkel et al. 1932).

The consensus would be considered achieved once 70% of the participants agree on an issue (Trevelyan and Robinson 2015).The qualitative methodology allowed for an 'insider' view of participants under study. Thematic analysis was done for the qualitative data as described previously. The data analysis was done manually. Quality assurance was established through the maintenance of credibility, dependability, transferability, and conformability.

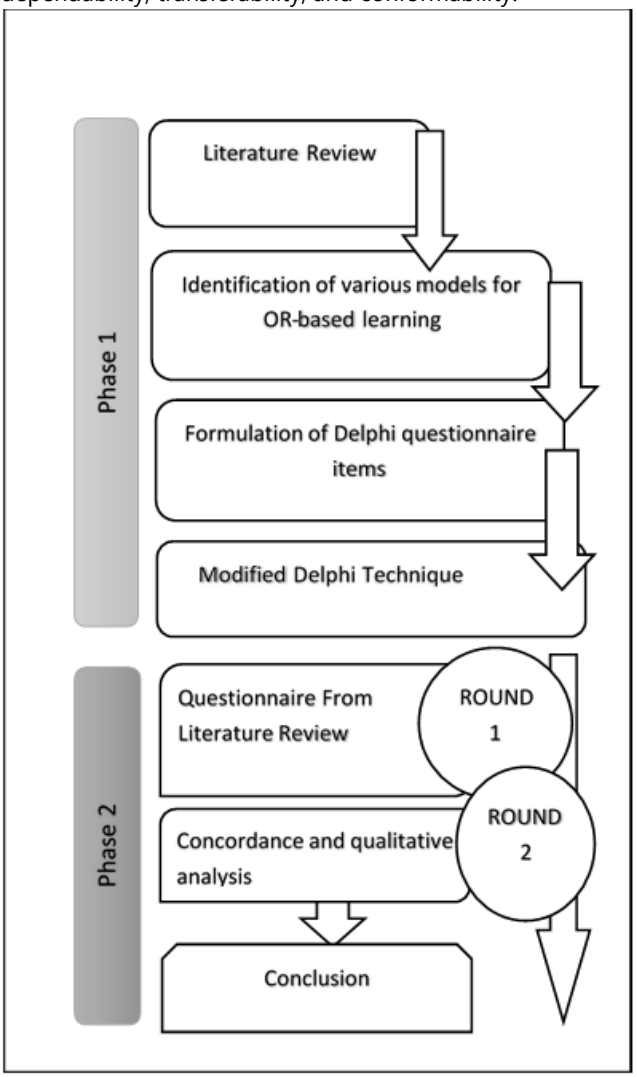

Figure 1: Methodology

In the Delphi study, participants included surgical teachers with extensive experience in medical education and medical students who had attended surgical rotations. 18 surgeons and surgical residents participated in this Modified Delphi Study. In the Delphi study, there are no hard and fast rules about sample size, as suggested by Linstone et al. (1978). It seems, therefore, that the decision about panel size is empirical and pragmatic, taking into consideration factors such as time and expense (Hasson 2000). Representation is assessed by the qualities of the expert panel rather than its numbers (Powell 2003). Therefore, in this study, the students and faculty members were purposively sampled to generate high-quality debate and opinions so that a meaningful scientific discussion could take place. Participants from the University of Lahore, the University of Health Sciences, King Edward Medical University, Riphah International Islamic University, Khyber Medical University, University of Dundee, and Queen Elizabeth Hospital Birmingham offering graduation in medicine were included for a diversity of opinion. All of these institutes are tertiary-level institutes with an excellent reputation and structured clinical programs. Faculty and undergraduate students from these institutes participated in this Delphi Study with the eventual aim of finding the optimal model for implementing in operating rooms based learning. Confidentiality was maintained, and participants' names were not used during any step; participants were given codes for their identity and analysis purposes. All of the participants were blinded from each other. Blinding ensured neutralization of the impact of higher positions of influence on the students. The foundations of research were maintained on ontological, epistemological, and methodological perspectives.

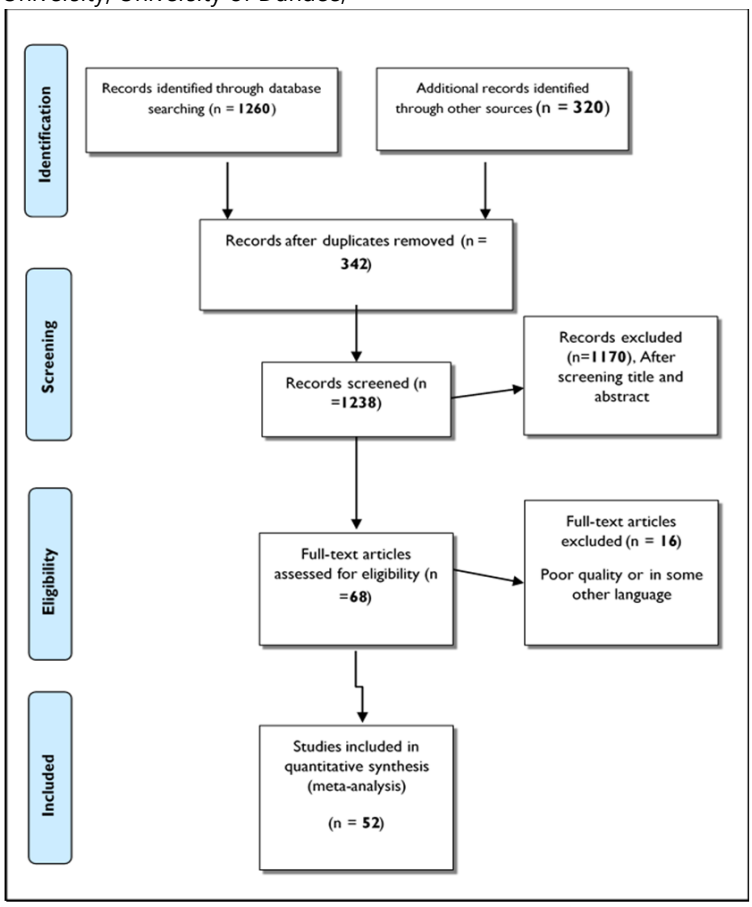

Figure 2: PRISMA Flow Chart for literature search

RESULTS

The results are presented in three phases as per sections of the study.

Phase 1: Literature Review on Factors Affecting Student Learning in OR: The literature search strategy identified a total of 1580 articles. 52 papers were included after the screening process by removing duplicates. Figure 2 explains

the process of literature search and article selection through a PRISMA flow chart. Selected papers were thematically analyzed for finding themes and subthemes affecting students learning in OR. The rest of the themes and subthemes emerged during the Delphi qualitative data input. If the literature review's detailed findings have been published elsewhere; their detailed overview has been omitted in this article to focus more on the Phase 2 findings here.

Phase 2: Modified Delphi Study Results: The study's participants were both faculty members with experience in teaching surgery and medical education and the participating students had undergone rotation in the surgery department. The participants belonged to diverse institutes, including local as well as institutes in the United Kingdom.

Relative Importance Of OR Based Learning Models—Quantitative Component

The participants evaluated the relative importance of learning models identified from the literature review through quantitative analysis of Delphi Round 1 and 2. The importance was scored on a scale of 0-5. The learning models most effective in OR-based learning of students discussed here in this study have been rated as either 'Quite Important' or 'Highly Important'. None were rated unimportant. The learning models were then prioritized based on scoring across 2 rounds of the Delphi technique.

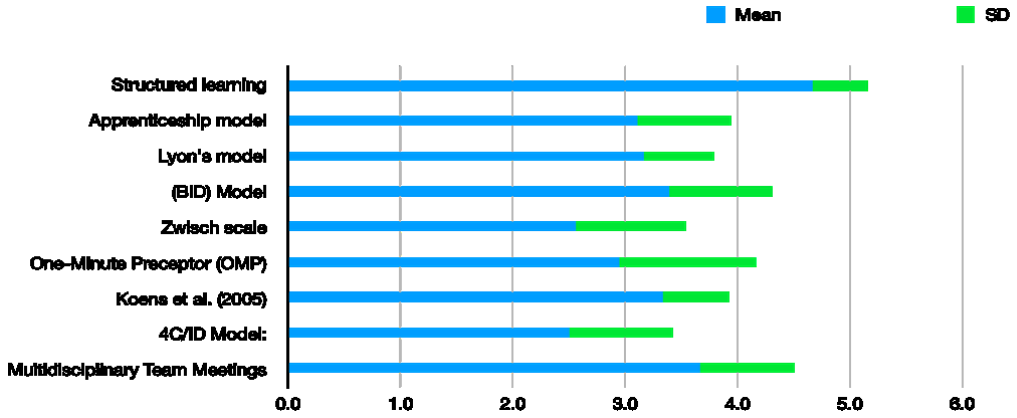

Figure 3: Quantitative Analysis of the Consensus Through Delphi Study: 18 experts with experience in surgical OR-related education participated in this first round of the study. Quantitative and qualitative analysis was done based on the filled Delphi questionnaire and the following observations were made. Most of the factors described based on the literature review were considered important. Most of the factors have been rated as either 'Quite Important' or 'Highly Important'. Only one factor related to student-driven personal learning objectives is considered 'Somewhat Important'. The relative rating is given in the table (Means±SD).

Relative Importance Of OR Based Learning Models—Qualitative Component

The qualitative analysis of emerging themes, subthemes, and axial codes through the Delphi Rounds was done and is presented in Table 2. Here we describe only the conclusions drawn from this analysis. The details of the final axial codes, themes, subthemes, and representative statements can be reviewed in Table 2.

The participants here clearly argue for more structured learning within the OR than the traditional opportunistic learning. A structured approach should at least cover the minimum standards that a graduate essentially requires. It should be a balanced program according to the specialty. The participants identified the advantages and disadvantages of a structured learning program. While structured learning is essentially goal-oriented, student-friendly, time-saving, and provides qualitative outcomes, it, however, has drawbacks owing to a lack of faculty and resources, time, and training, in addition to the unavailability of OR and surgical cases. The participants identified potential problems in the implementation of a structured learning process. The participants formulated components in making the structured learning meaningful. The participants also explored the idea of synchronization of OR-based learning with simulated lab activities and the use of technology in this aspect. The participants also emphasized the need for training the faculty for the structured OR-based learning programs. The participants reached a consensus on the usefulness of the traditional Apprenticeship model but also realized the drawbacks of it such as lack of interest and commitment from either student or the teacher, it being time-bound and the dire need of the training of the faculty for this model to work. Lyon's model (P Lyon 2004) was well

accepted among the majority of participants as highly useful. Regardless of it being a convenient form of learning, it was effective only if the resident could self-regulate. The Briefing-Intraoperative teaching-Debriefing (BID) model (Roberts et al. 2009) was much appreciated by the participants because it was useful in teaching larger audiences and post-simulation discussions were very effective. The Zwisch model, originally designed by Dr. Joseph Zwischenberger in 2013, was not very appreciated although it was largely identified as a useful modality to be used within resident training. The One Minute Preceptor (OMP) model (Lap Ki Chan and Jeffrey Wiseman 2011) made efficient use of time and could be used in theater as well as in simulations. Koen's model (Koens et al. 2005) was highly appreciated by the participants due to its usefulness in the application of surgical knowledge. Koen's model employed the technique of virtual patients for learning. The Four-Component-Instructional-Design (4C/ID) model (Vandewaetere et. al 2014) was not popular with the participants as it was difficult to implement. Multi-disciplinary Mortality and Morbidity meetings were a much-preferred form of learning model amongst all participants.

DISCUSSION

Standardized graduates are need of the hour so that they can function anywhere in the world optimally, and a uniform level of healthcare can be provided. However, standardization has an inherent flaw in that it is usually done for leveling the average. Hence, standardized learning strategies do not account for differently gifted students. Another drawback of this approach is the potential loss of diversity in medical education.

Moreover, personal learning objectives are essential for the sharpening of focused minds. Hence, the structured learning process should have a window of consumption for exceptional minds. The curricula need to have room for a self-driven intellectual brought up through personalized learning objectives and create opportunities in this regard. In summation, a predominantly structured program with well-organized lessons would likely be an optimal option for an adequate learning experience in the operating room. However, for some segments of learning and for students who take initiative, opportunities for personal learning objectives and self-driven learning should be encouraged.

Many models are currently being used for the student and resident learning in OR, which varies based on agenda – the freedom for the student to decide learning objectives and modalities of learning.

The apprenticeship model has been the mostly applied informal way of teaching and learning in the field of surgery. This model is based on the "principle of shadowing", which means the resident follows the trainer in terms of practice, follows his cues, and over time the skill is inculcated into the resident. Residents typically follow the 'see one-do one' approach. The teachers have a dominant role within the OR setting. Their interest, competence, attitude, quality of feedback, and encouragement positively influence OR-based learning. Fear, intimidation, and bullying negatively affect student learning and should be discouraged. Teachers and staff's welcoming attitude has a positive impact. Considering the teachers' rate-limiting role within the OR setting, it remains imperative to focus on faculty training.

Many authors (Lyon 2004b; Weinberg et al. 2015) have previously argued for student-led education in operating rooms. Lyon's model of learning stands on the principles of andragogy and adult learning. The authors argue for student-driven learning in the operating room as surgeons are often busy due to competing responsibilities and activities (P. Lyon, 2004b). Lyon et al. have identified various challenges posed to a student in the OR environment which are conceptualized around 3 key domains: the challenge posed by the physical environment; the challenge of the educational task, and the challenge of negotiating a role as a student participant within operating rooms. This model provides diversity and opportunities for students to drive the learning process. However, this model defines the benefits of standardization of medical graduates.

Students usually prefer Robert et al.'s Briefing-Intraoperative Teaching-Debriefing (BID) model for teaching at the resident and student levels. The BID model, is not something new but knowingly or unknowingly has been part of traditional OR-based learning over centuries. It constitutes a three-step process of OR-based learning i.e. Briefing, Intra-operative Teaching, and Debriefing. 'Briefing' is a short 2-3 minutes interaction with learners before an operative procedure, which encompasses learning objectives, learning need assessment, and process of learning activity. Intraoperative teaching is primarily a didactic walk of the procedure, which is a two-way productive interaction between the learner and the teacher, with the ultimate goal of skill transfer and independence of the learner in terms of performing the procedure. The Debriefing session consists of feedback and reflection provided by both the learner and the teacher with the ultimate aim of achieving conceptual clarity. This technique is quite useful for imparting learning about surgical procedures—many of the participants of our study concur with this model's utility.

Table 1 Qualitative responses were analyzed by thematic analysis given in the table below. Highlighted items are subthemes that emerged through this thematic analysis.

IMPORTANCE RATING OF THEMES AND SUBTHEMES OF QUALITATIVE ANALYSIS

Themes	**Subthemes**	**Relative Importance on Likert Scale (1-5) Mean±SD**	**% of participants who rate factors either Quite or Highly relevant**	**Qualitative Analysis: Final Codes**
Learning in OR	Should OR-based learning be structured or opportunistic?	4.7 ± 0.5	100%	**Requisites/Essentials of the structured approach** 1. A structured approach should at least cover the minimum standards that a graduate essentially requires. 2. It should be a well-balanced program according to specialty and cases for operation available. 3. To diversify the learning process, the curriculum must have some space for self-regulated learning as well but that should not replace the minimum essential structured component. **Provision of opportunities** 1. Structured learning provides equal opportunities for the students to learn and establish themselves as equally competent graduates. 2. It paves the way for the best opportunities. **Assessment Tool** It helps gauge the learning experience of students.
	Advantages and disadvantages of structured learning	NA	NA	**Advantages :** **Student-friendly approach** ● Structured learning keeps the students focused ● It develops the interest of students **Goal-oriented learning** ● Students know what to expect on the day and in the environment and students can prepare for it in advance. ● Helps mark the milestones which a student needs to cover ● Helps students realize that this much learning is expected of them ● Provides a guideline in the form of a curriculum **Assessment Tool for Students** ● Helps the student mark what he does know and does not know ● Helps students to identify and focus on areas they are deficient in. ● Early recognition of the learner's mistake and timely resolution of faults ● Structured formative assessments are possible **Time-Saving** ● Most procedures and techniques don't need repetition **Provision of opportunities** ● Equal opportunities for all **Quality of product** ● Outstanding surgeons will be produced **Disadvantages:** **Lack of faculty and resources** ● More faculty engagement especially in setups where they are already over-burdened and have limited resources. ● More gadgets required to observe surgery **Lack of time** ● Structured training programs are difficult to implement in public or busy setups because the workload is huge ● Lots of time required to implement structured training **Lack of training** ● Training of the trainers required ● Lack of uniform facilities and trainers at different centers

				Unavailability of OR and cases ● The ORs are day and time-bound Availability of cases in correspondence to the structured program may not always be possible
	Potential problems in the implementation of the structured learning process	NA	NA	**Potential problems:** **Unavailability of cases** ● Clinical cases may not always be available at the time of teaching of that particular topic **Inapt circumstances in OR** ● Operation theater is a high-pressure setting where surgeons have to deliver at multiple fronts so implementing any structured learning process would require special arrangements, dedication, and conviction to make it work. **Need for compatibility and cooperation** ● The system would have to adapt to the learning requirements and has to be compliant with the needs of the learning process and at this point, the surgical operation theater leadership has to play a constructive role. The teachers responsible for curricular design need to liaise with the stakeholder effectively
	Components in making structured learning meaningful	NA	NA	**Components:** **Planned curriculum and learning objectives** ● A predefined list of procedures and techniques to observe at emergency and elective OR/ a set syllabus or curriculum for the students to complete ● Active and passive learning with smart and well-aligned objectives **Surgical ethics and protocol** ● Development of attitude and surgical ethics ● Comprehension and compulsion of aseptic techniques and subsequently building habits **Learning and practicing skills** ● Skill acquisition through engaging students in operation theaters ● Hands-on experience of specific techniques **Roles in Operating Room** ● Operating room's leadership ● Interdisciplinary approaches **Group and inter-group discussions** ● Cognitive development through preoperative case discussions ● Discussions among the students of various specialties and disciplines ● Discussions among students and residents and professors at all tiers and levels ● Panel discussions **Reporting and recognizing errors** ● Reporting of any complication if it occurs ● Mortality and morbidity meetings aiming to find what could have been done ● Audits; qualitative and quantitative **Attendance and assessment** ● Compulsory attendance of the elective and emergency ORs for specific periods ● Regular evaluation of students and residents after specific intervals **Feedback before and after the session** ● Students input when the composition of the content of the program is made Feedback from the students after going through the program
	Synchronization of OR-based learning with simulated lab-based activities	NA	NA	**Unrestricted access to labs** ● Simulation labs are not time-bound and could be used at odd hours **Learning and practicing skills** ● Simulations could be a way to introduce the students to some particular skills ● Simulation-based learning covers the psychomotor and affective domains of OR-based learning. ● Step by step learning will create an order to appraise the lag of learner ● A logbook can document the amount of time spent on learning specific skills under supervised guidance **Learning from observation and demonstration** ● Synchronization by practicing in simulation labs whatever has been observed in ORs

				• See one, do one, and teach one principle that can be easily applied in simulation labs. For example, trainers can demonstrate laparoscopic suturing in simulation labs over and over again **Constructive feedback** • Instant feedback to the student with suggestions for improvement **The safe and risk-free practice of skills** • Simulations help students practice without guilt and without unnecessarily risking patient safety until they perfect a particular skill so it can be performed on real patients No inadvertent harm to real patients which is highly likely with inexperienced trainees or students
	Use of technology in OR-based learning	NA	NA	**Latest technology in OR - a healthcare necessity** • Technology in many forms is revolutionizing the OR environment and students need to not just familiarize themselves but learn it all • The need for the latest technology and facilities for diagnosis and management of patients • 3D imaging **Tele-education and E-learning** • Live surgery telecasts in classrooms and on social media enhance learning for large groups while staying at a safe distance • Visual memory is enhanced for many people at a time • Creates a learning environment • Recorded videos can be used for teaching • Online teaching sessions **Intraoperative teaching using a visual aid** • Anatomical drawings and atlas projections while performing corresponding surgeries for a better grasp and understanding of students **Hands-on learning** • Simulations based learning Skills lab
	Training of faculty for OR-based learning of medical students	NA	NA	**Training of faculty** • Faculty development programs • Training the trainers formally. • Direct supervision of training faculty **Essentials of the training** • By encouraging the trainers to review literature • Attending online courses and international courses • Encouraging more time to be spent in simulation labs • Role modeling **Objectives for the trainers** • A curriculum should be devised • Preplanned instructor manual • The teaching roster of the trainers set and thoroughly implemented **Using online platforms and soft wares** • Moodle like platforms **Appreciation of the trainers** • Certificates and diplomas in medical teaching Feedback of the trainers from the students and residents

DIFFERENTIAL EXAMINATION OF OR LEARNING MODELS

Models	Apprenticeship model "Principle of Shadowing"	3.1 ± 0.8	72%	**Advantages**: • A well known, traditional, and effective way of teaching • Positively affect the students' learning • Students can find mentors and guidance Students can participate in more advanced individual activities **Disadvantages**: **Lack of interest and commitment**

				• Medical students on rotations may not be aiming for that specialty and may not show an active interest in it • Lack of commitment on students' behalf • The learning graph isn't rapidly progressive • The student may not have good observational quality **Time-bound learning** • Medical students on rotations come for a limited period so this model is difficult to apply for them • Longer and meaningful exposure is required • A limited number of residents/students get the chance to learn maximum **Problems related to trainers** • The trainer's training quality can affect the learning • The trainer may be busy or overworked • Lack of commitment on trainers' behalf • Requires designated faculty with specific students More entrustment is required
	Lyon's Model	3.2 ± 0.6	88%	**Advantages**: **Convenient learning** • Discussions with colleagues are easier and comfortable in comparison to those with condescending seniors • It could be used for student's "additional" personal learning objectives **Dependent factors** • It is effective only if the resident can self-regulate • It depends on the type of OR. Capacity, types of cases operated, number of students and their attitude and aptitude **Making Interpretations** • Interprets learning and teaching in OR Learning involves interpreting the student and surgeons' behavior, style, attitude, and consequences of the decision **Disadvantages**: **Lack of interest** • Undergraduates usually don't show much responsibility towards their learning in OR **Downsides of self-regulated learning** • Self-regulated learning may not be able to produce standardized graduates and many components of graduate learning may be missed in a self-dictated learning **Surgeon's priorities** • OR environment is very demanding. While most of the focus is kept on the patient's wellbeing, safety, and avoiding complications, the students are often ignored Time restraints from the surgeon and academic point of view
	Briefing-Intraoperative teaching-Debriefing (BID) Model	3.4 ± 0.9	72%	**Advantages:** • Teaching a larger audience • Much helpful in comparatively large setups • Good for rotations of a medical student as many students can be accommodated • Post-simulation discussion • Could be effectively used after simulation-based learning **Disadvantages:** • Surgeon's disregard • As teachers, surgeons don't intend to train students, so it is not that pertinent • Insufficient teaching/training • Residents require deeper knowledge. This model will not suffice their needs
	Zwisch model	2.6 ± 1	55%	**Advantages:** **Learning basic skills and instruments** • Effective for basic techniques such as gloving, scrubbing, stitch removal, and different types of dressings

				• Extremely useful for initial training of the interns and residents Producing competent and confident residents • Assesses and analyzes the competence level of residents and the faculty can delegate the autonomy to the resident accordingly • Boosts the confidence of the resident **Disadvantages:** **Limited to few skills** • Can be applied to learning only a few techniques **Lack of consideration for undergraduates** • Students are almost novice in the field and not much work at student levels • Surgeons avoid delegating autonomy to undergraduate students for the safety of patients so this model has the least implication
	One-Minute preceptor (OMP)	2.9 ± 1.2	61%	**Advantages:** **Time productivity** • A very effective way to use the time between the procedures Incorporating OMP in OR learning • There are always some important learning moments in OR-based learning which needs to be harnessed effectively and OMP can be a wonderful strategy for that **Incorporating OMP in simulation training** • If this technique is applied with simulation-based learning, it will be very effective **Disadvantages:** **Inapt circumstances in OR** • Considering the workload of OR, the way they work, it is quite difficult
	Koens model	3.3 ± 0.6	94%	**Advantages:** **Application of knowledge practically** • Helps to comprehend the knowledge learned in classrooms and wards • The combination of practical and clinical knowledge implemented with theoretical knowledge enhances the learning and better understanding of salient points • Reduced and enhanced ends are crucial in learning to analyze progress **Use of virtual patients for learning** • Virtual patients make a good example and if employed effectively, they can improve the clinical decision-making process of students **Disadvantages:** **Unequal chances at learning** • Not all students can have a chance or opportunity to see the same thing closely. Only a limited number of students or residents can work as assistants so limited chances. **Difficult to carry out** • They are difficult to construct and a lot of effort is required by the faculty members
	Four component instructional design model (4C/ID)	2.5 ± 0.9	33%	**Advantages:** **Learning in sections/components** • Most procedures and techniques are learned better if divided into components Long term committed teaching • If applied for cases of continuous and more committed teaching on a long term basis where a long term plan can be made **Precision by repetition** • Repetitive difficult tasks and repetitive feedback will make learning meticulous **Disadvantages :** **Unfitting and difficult** • Small procedures and techniques might not need compartmentalization so cannot always be utilized • Difficult
	Multidisciplinary Team Meetings and Mortality and Morbidity Meetings	3.7 ± 0.8	88%	**Advantages:** **Learning by a multidisciplinary approach** • The involvement of consultants of different specialties enhances learning by giving deep insight into different aspects of procedure and management protocol **Participation of students**

				• Even at lower levels i.e. students can attend these meetings, listen to discussions and get learning points and relate that to relevant cases later on. **Case discussions and decision making as a team** • It helps in reviewing the case to case studies. • Individual cases help to develop a rational decision, helps in teamwork and leadership skills with feedbacks regarding decision making with equal responsibilities **Disadvantages:** **Lack of experience for active participation of students** • Students require more in-depth knowledge and experience to participate effectively in these meetings **Incompatibility of cases with clinical rotations** • It cannot work out as a planned syllabus manner because the types of cases cannot be predicted for the period students are allocated to the very clinical rotation
	Any other model, modality, and technique that can be helpful	NA	NA	• Designate PGs to teach • Structured learning of most importance • Simulated environments • Learning first, then teaching • Residents should be regularly evaluated • Feedback should be regularly taken and reviewed seriously

In line with Roberts et al., this study finds that students prefer a more structured learning plan. They feel that teachers can more appropriately choose learning objectives corresponding to the expected skill set required by a graduate, with more experience in this field and having gone through this experience themselves beforehand. Moreover, they are more comprehensively exposed to various aspects of medical learning and patient care and are likely to make better decisions in favor of their patients. However, they would like to participate in selecting modalities to be used for achieving these learning objectives.

To assess and calibrate a resident's level of competence and to delegate autonomy of the operative work with patient safety the concept of EPAs and Zwisch scale has been developed. The resident is evaluated for any surgical intervention on a scale of "Show & Tell," "Smart Help," "Dump Help," and "No Help" in terms of senior support required and then is given autonomy based on that. The model provides both faculty and residents a lexicon with which to discuss the expected role of autonomy in the future of surgery.

One-Minute Preceptor (OMP) model for teaching micro-skills: for a smaller subset of skills in the operating room, OMP can be a very useful strategy both for residents and medical students. Short activities can be carefully planned in a typical moment of learning in OR and this learning modality has demonstrated a track record of being productive. This modality is based on a 5-step process, consisting of (1) getting learner commitment, (2) probing for clinical reasoning, (3) teaching of general rules, (4) reinforcing good performance or providing positive feedback, and (5) correcting poor performance. Thus, OMP is an effective strategy for clinical encounters within an ambulatory setting, operating theater, and simulation lab.

Koens et al. (2005) developed a model for considering the role of the context within medical education. The model is based on principles of experiential learning. For a learning activity to have a stronger impact on the learner and more enhanced cognitive and psychomotor retention, physical, sematic, and commitment contexts need to be added. For example, studying the anatomy of the inguinal canal, alone in the library, will be at the reduced end. In contrast, learning within the OR as a surgeon operates on a hernia when the learner can see the anatomy, will be at an enhanced end. The semantic or cognitive dimension provides a relationship between the learner's knowledge and the learning task. For example, a simple task of learning facts, such as three causes of splenomegaly, will be at the reduced end. In contrast, to see patients undergoing splenectomy for idiopathic thrombocytopenic purpura (ITP) will be at the enhanced end. The commitment dimension deals with the learner's motivation.

The 4C/ID model's utility can be employed successfully for learning skills within the simulated or standardized environment. This model is a structured modern form of the apprenticeship model for operative learning. The four-component instructional design model (4C/ID) stands on chunking repetitive difficult tasks to smaller more manageable components with repetitive feedback which is gradually replaced with reflection as the learner gains expertise. This model follows motor learning theory and theories related to feedback and reflection. This approach deals with persistent problems like compartmentalization; separation of a whole competence in distinct parts or categories like declarative knowledge, procedural knowledge, and attitudes; fragmentation, breaking complex skills or competencies in smaller parts without taking into account the interactions between the parts; and the transfer paradox, when students learn complex tasks in an isolated manner, it will be more difficult for them to transfer what they have learned to the reality of the work settings because what works well for reaching isolated, specific objectives often does not work when it comes to reaching integrated objectives (Vandewaetere et al., 2015). However, this model's application or the apprenticeship model for students may not be practically feasible considering the number of students, safety and ethical issues, and time constraints. Hence for every learning encounter or designed activity, an appropriate model would require selection, and the encounter's structure would change accordingly.

Likewise, students' motivation and desire to learn, preparedness, and skill to use self-regulated learning can influence their quality of learning experience. The organization needs to be supportive in infrastructure and adequate visual and skill lab support to improve OR learning experience.

LIMITATIONS

Although there is a reasonable amount of literature available related to factors that influence medical students learning, the data is contextual. The data is based on opinions without sound scientific evidence and may not be generalized. Some studies have a low response rate signifying non-response bias that limits both the studies' reliability and validity.

This study is also based on the participants' perceptions and thoughts. It possesses inherent flaws of the Delphi technique, which is again opinion-based data collection that

cannot completely exclude personal biases. In the future, it would be necessary to explore various models of learning and teaching within the OR setting.

ARTICLE INFORMATION Accepted for Publication: May 21, 2021, Published Online: March 30, 2022. https://doi.org/10.48111/2022.01.00

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Financial Support and Sponsorship: Nil.
Conflicts of Interest: There are no conflicts of interest

REFERENCES

1. Ahmed M, Arora S, Russ S, Darzi A, Vincent C, Sevdalis N. 2013. Operation debrief: A SHARP improvement in performance feedback in the operating room. *Ann Surg*. 258(6):958–963.

2. Al-eraky MM, Donkers J, Wajid G, Merrienboer JJGVAN. 2014. A Delphi study of medical professionalism in Arabian countries : The Four-Gates model.

3. Bauer F, Rommel N, Kreutzer K, Weitz J, Wagenpfeil S, Gulati A, Wolff KD, Kesting MR. 2014. A novel approach to teaching surgical skills to medical students using an ex vivo animal training model. *J Surg Educ*.

4. Boulkedid R, Abdoul H, Loustau M, Sibony O, Alberti C. 2011. Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review. *PLoS One [Internet]*. [accessed 2019 Jul 21] 6(6):e20476. http://www.ncbi.nlm.nih.gov/pubmed/21694759

5. Bowrey DJ, Kidd JM. 2014. How Do Early Emotional Experiences in the Operating Theatre Influence Medical Student Learning in This Environment? *Teach Learn Med [Internet]*. [accessed 2019 Jul 5] 26(2):113–120. http://www.tandfonline.com/doi/abs/10.1080/10401334.2014.883986

6. Broderick TJ, Russell KM, Doarn CR, Merrell RC. 2002. A Novel Telemedicine Method for Viewing the Open Surgical Field. *J Laparoendosc Adv Surg Tech*.

7. Chapman SJ, Hakeem AR, Marangoni G, Raj Prasad K. 2013. How can we enhance undergraduate medical training in the operating room? A survey of student attitudes and opinions. *J Surg Educ*.

8. Chaudhry Z, Campagna-Vaillancourt M, Husein M, Varshney R, Roth K, Gooi A, Nguyen L. 2019. Perioperative Teaching and Feedback: How are we doing in Canadian OTL-HNS programs*? J Otolaryngol - Head Neck Surg*.

9. Cope A, Bezemer J, Sutkin G. 2019a. Models of Teaching and Learning in the Operating Theatre. In: Nestel D, Dalrymple K, Paige JT, Aggarwal R, editors. *Adv Surg Educ Theory, Evid Pract [Internet]. Singapore: Springer Singapore;* p. 171–182. https://doi.org/10.1007/978-981-13-3128-2_16

10. Cope A, Bezemer J, Sutkin G. 2019b. Models of Teaching and Learning in the Operating Theatre. In: [place unknown]: *Springer, Singapore;* p. 171–182.

11. Cope AC, Mavroveli S, Bezemer J, Hanna GB, Kneebone R. 2015. Making Meaning from Sensory Cues: A Qualitative Investigation of Postgraduate Learning in the Operating Room. *Acad Med*. 90(8):1125–1131.

12. Croghan SM, Phillips C, Howson W. 2019a. The operating theatre as a classroom: a literature review of medical student learning in the theatre environment. *Int J Med Educ*.

13. Croghan SM, Phillips C, Howson W. 2019b. The operating theatre as a classroom: a literature review of medical student learning in the theatre environment. *Int J Med Educ [Internet]*. [accessed 2019 Jul 5] 10:75–87. http://www.ijme.net/archive/10/operating-theatre-classroom/

14. Fernando N, McAdam T, Youngson G, McKenzie H, Cleland J, Yule S. 2007. No Title. *Surgeon*. 5(5):271.

15. Flannery T, Gormley G. 2014a. Evaluation of the contribution of theatre attendance to medical undergraduate neuroscience teaching-A pilot study. *Br J Neurosurg*.

16. Flannery T, Gormley G. 2014b. Evaluation of the contribution of theatre attendance to medical undergraduate neuroscience teaching – A pilot study. *Br J Neurosurg [Internet]*. [accessed 2019 Jul 5] 28(5):680–684. http://www.tandfonline.com/doi/full/10.3109/02688697.2014.896873

17. Flinn JT, Miller A, Pyatka N, Brewer J, Schneider T, Cao CGL. 2016. The effect of stress on learning in surgical skill acquisition. *Med Teach*.

18. Fraenkel JR, Wallen NE, Hyun HH. 1932. How to Design and Evaluate Research in Education. [place unknown].

19. Gallagher KC, Matevish LE, Neuzil K, Evans PT, Eastham SC, Terhune KP, Eskind SJ. 2019. Peer-led Surgical Clerkship Programming Support Through the General Surgery Interest Group at the Vanderbilt University School of Medicine. *J Surg Educ [Internet]*. [accessed 2019 Aug 4]. http://www.ncbi.nlm.nih.gov/pubmed/31129002

20. Hampton BS, Magrane D, Sung V. 2011. Perceptions of operating room learning experiences during the obstetrics and gynecology clerkship. *J Surg Educ*.

21. Hasson F. 2000. Research guidelines for the Delphi survey technique. *J Adv Nurs [Internet]*. [accessed 2019 Jul 22] 32(4):1008. http://doi.wiley.com/10.1046/j.1365-2648.2000.01567.x

22. Hee JM, Yap HW, Ong ZX, Quek SQM, Toh YP, Mason S, Krishna LKR. 2019. Understanding the Mentoring Environment Through Thematic Analysis of the Learning Environment in Medical Education: a Systematic Review. *J Gen Intern Med*.

23. Hexter A, Hunter A. 2019. Response to: Factors that influence medical student learning in the operating room: Medical students' perspective. *Med Teach*.

24. Hexter AT, O'Dowd-Booth C, Hunter A. 2019a. Factors that influence medical student learning in the operating room. *Med Teach [Internet]*. [accessed 2019 Jul 5] 41(5):555–560. https://www.tandfonline.com/doi/full/10.1080/0142159X.2018.1504163

25. Hexter AT, O'Dowd-Booth C, Hunter A. 2019b. Factors that influence medical

student learning in the operating room. *Med Teach [Internet]*. [accessed 2019 Jul 5] 41(5):555–560. https://www.tandfonline.com/doi/full/10.1080/0142159X.2018.1504163

26. Hexter AT, O'Dowd-Booth C, Hunter A. 2019c. Factors that influence medical student learning in the operating room. *Med Teach [Internet]*. [accessed 2019 Jul 21] 41(5):555–560. https://www.tandfonline.com/doi/full/10.1080/0142159X.2018.1504163

27. Irani JL, Greenberg JA, Blanco MA, Greenberg CC, Ashley S, Lipsitz SR, Hafler JP, Breen E. 2010. Educational value of the operating room experience during a core surgical clerkship. *Am J Surg [Internet]*. [accessed 2019 Jul 5] 200(1):167–172. https://linkinghub.elsevier.com/retrieve/pii/S0002961009006278

28. Kable AK, Pich J, Maslin-Prothero SE. 2012. A structured approach to documenting a search strategy for publication: A 12 step guideline for authors. *Nurse Educ Today*. 32(8):878–886.

29. Labadie B, Patel RM, Gandy Labadie J, Hwang C, Okhunov Z, Landman J. 2017. Assessing the Effect of an Intensive 2-Week Surgical Training and Innovation Program for High-School Students. *J Surg Educ*.

30. Landry EC, Yong M, Pauwels J, Chadha NK. 2019. The use of video glasses improved learning of tonsillectomy and adenoidectomy surgery: A randomized controlled trial. *Int J Pediatr Otorhinolaryngol*.

31. Lee SC, Huang H, Minard CG, Schackman J, Rajagopalan S. 2018. The use of podcast videos for airway skills. *Clin Teach*.

32. Linstone HA, Turoff M, Helmer O. The Delphi Method Techniques and Applications Edited by. [place unknown].

33. Lyon P. 2004a. A model of teaching and learning in the operating theatre. *Med Educ [Internet]*. [accessed 2019 Jul 5] 38(12):1278–1287. http://doi.wiley.com/10.1111/j.1365-2929.2004.02020.x

34. Lyon P. 2004b. A model of teaching-learning in the operating theatre. *Med Educ*.

35. Lyon P. 2004c. A model of teaching-learning in the operating theatre. *Med Educ*. 38(12):1278–1287.

36. Maggio LA, Cate O Ten, Irby DM, O'Brien BC. 2015. Designing evidence-based medicine training to optimize the transfer of skills from the classroom to clinical practice: Applying the four-component instructional design model. *Acad Med*. 90(11):1457–1461.

37. Martin TG, Clarke DR, Bowrey DJ. 2012. Medical students in theatre: Setting the scene. *Med Teach [Internet]*. [accessed 2019 Jul 5] 34(4):337–337. http://www.tandfonline.com/doi/full/10.3109/0142159X.2012.661892

38. Massarelli A, Martini JG, Lino MM, Spenassato D, Massaroli R, Massaroli A, Martini JG, Lino MM, Spenassato D, Massaroli R. 2018. MÉTODO DELPHI COMO REFERENCIAL METODOLÓGICO PARA A PESQUISA EM ENFERMAGEM. Texto Context - *Enferm [Internet]*. [accessed 2019 Jul 21] 26(4). http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-07072017000400320&lng=pt&tlng=pt

39. van Merrienboer JJG, Dolmans DHJM. 2015. Research on instructional design in the health sciences: From taxonomies of learning to whole-task models. In: *Res Med Educ*. [place unknown]: Wiley; p. 193–206.

40. Monkhouse S. 2010. Learning in the surgical workplace: Necessity not luxury. *Clin Teach*.

41. Morzycki A, Hudson A, Williams J. 2016. Medical Student Presyncope and Syncope in the Operating Room: A Mixed-Methods Analysis. *J Surg Educ*.

42. Moulton CA, Regehr G, Lingard L, Merritt C, MacRae H. 2010. Operating from the Other Side of the Table: Control Dynamics and the Surgeon Educator. *J Am Coll Surg*. 210(1):79–86.

43. Nasiri M, Amirmohseni L, Mofidi A, Pires Padilha Paim C, Bigdeli Shamloo MB, Asadi M. 2019. Educational games developed for students in perioperative nursing: A systematic review and appraisal of the evidence. *Nurse Educ Pract*.

44. O'Neill R, Shapiro M, Merchant A. 2018. The Role of the Operating Room in Medical Student Education: Differing Perspectives of Learners and Educators. *J Surg Educ*.

45. Palmer EJ, Devitt PG. 2007. Assessment of higher-order cognitive skills in undergraduate education: modified essay or multiple choice questions? Research paper. *BMC Med Educ*. 7:1–7.

46. Pilieci SN, Salim SY, Heffernan DS, Itani KMF, Khadaroo RG. 2018. A Randomized Controlled Trial of Video Education versus Skill Demonstration: Which Is More Effective in Teaching Sterile Surgical Technique? *Surg Infect (Larchmt)*.

47. Pope C, Smith A, Goodwin D, Mort M. 2003. Passing on tacit knowledge in anaesthesia: A qualitative study. *Med Educ*. 37(7):650–655.

48. Powell C. 2003. The Delphi technique: myths and realities. *J Adv Nurs [Internet]*. [accessed 2019 Jul 21] 41(4):376–382. http://doi.wiley.com/10.1046/j.1365-2648.2003.02537.x

49. Ravindra P, Fitzgerald JE, Bhangu A, Maxwell-Armstrong CA. 2013. No Title. *J Surg Educ*. 70(4):495.

50. Ravindra Pravisha, Fitzgerald JEF, Bhangu A, Maxwell-Armstrong CA. 2013. Quantifying Factors Influencing Operating Theater Teaching, Participation, and Learning Opportunities for Medical Students in Surgery. *J Surg Educ [Internet]*. [accessed 2019 Jul 5] 70(4):495–501. https://linkinghub.elsevier.com/retrieve/pii/S1931720413001128

51. Roberts NK, Williams RG, Kim MJ, Dunnington GL. 2009. The Briefing, Intraoperative Teaching, Debriefing Model for Teaching in the Operating Room. *J Am Coll Surg*. 208(2):299–303.

52. Rothenberger J, Seyed Jafari SM, Schnabel KP, Tschumi C, Angermeier S, Shafighi M. 2015. Evaluation of medical students' attitudes and performance of basic surgery skills in a training program using fresh human skin, excised during body contouring surgeries. *J Surg Educ*.

53. Rüetschi U, Olarte Salazar CM. 2020. An e-Delphi study generates expert consensus on the trends in future continuing medical education engagement by resident, practicing, and expert surgeons. *Med Teach*. 42(4):444–450.

54. Schwind Cathy J., Boehler ML, Rogers DA, Williams RG, Dunnington G, Folse R, Markwell SJ. 2004. Variables influencing medical student learning in the operating room. *Am J Surg*.

55. Schwind C J, Boehler ML, Rogers DA, Williams RG, Dunnington G, Folse R, Markwell SJ. 2004. No Title. Am J Surg. 187(2):198.

56. Shipper ES, Miller SE, Hasty BN, De La Cruz MM, Merrell SB, Lin DT, Lau JN. 2018. Determining the educational value of a technical and nontechnical skills medical student curriculum. *J Surg Res*.

57. Torbjörnsson E, Olivecrona C, Sonden A. 2018. An interprofessional initiative aimed at creating a common learning resource for the operating room ward. *J Interprof Care*.

58. Trevelyan EG, Robinson PN. 2015. Delphi methodology in health research: how to do it? *Eur J Integr Med [Internet]*. [accessed 2019 Jul 21] 7(4):423–428. https://www.sciencedirect.com/science/article/abs/pii/S1876382015300160

59. Vandewaetere M, Manhaeve D, Aertgeerts B, Clarebout G, Van Merriënboer JJG, Roex A. 2015. 4C/ID in medical education: How to design an educational program based on whole-task learning: AMEE Guide No. 93. *Med Teach*. 37(1):4–20.

60. Weinberg D, Saleh M, Sinha Y. 2015. Twelve tips for medical students to maximise learning in theatre. *Med Teach.*

61. Williams PL, Webb C. 1994. The Delphi technique: a methodological discussion. *J Adv Nurs [Internet]*. [accessed 2019 Jul 21] 19(1):180–186. http://doi.wiley.com/10.1111/j.1365-2648.1994.tb01066.x

62. Zundel S, Wolf I, Christen HJ, Huwendiek S. 2015. What supports students' education in the operating room? A focus group study including students' and surgeons' views. *Am J Surg.*