

Chapter 16

Models of Teaching and Learning in the Operating Theatre



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Overview This chapter presents an evidence-based overview of what is known about content and process of teaching and learning in the operating theatre. It starts out by identifying theoretical perspectives on learning and teaching and their methodological implications. Following that the possibilities and challenges of teaching and learning in the operating theatre are explored, highlighting its distinct features as an educational venue. In the following parts, various teaching methods and typologies of content domains of learning are discussed and illustrated. The remainder of the chapter is focused on the verbal, gestural and haptic features of interactions between surgical educator, trainees and other members of the team. The chapter ends with questions for further research and a summary.

16.1 Introduction

Surgery is a craft specialty, requiring integrated knowledge, skill and decision making. To allow for these components to come together, the operating theatre is a key venue for learning. There is a long history of education in the operating theatre as the early operating rooms of the 1800s were designed as amphitheatres with steeply

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racked seating to afford a view to medical students and other surgeons. Yet, despite the long history of teaching and learning in the operating theatre, academic research into intraoperative teaching is a relatively young discipline.

16.2 Theoretical Perspectives

As surgical education researchers, we often get asked the big question: ‘What is the best way to teach in the operating theatre?’ There are two ways to go about answering this question:

1. Identifying which model works best. This is based on the idea of one-size-fits-all and caters for the ‘average’ learner. Methodologically this would be best studied using an experimental study design.
2. Abandoning the idea that there is a single best model of intraoperative teaching and instead assuming that there are a range of different ways of teaching and that the most apt approach will depend on the learner’s prior knowledge and skill and the possibilities afforded by the case. This is more of a situated perspective, in which learning is individualised, opportunistic and unique for each case. Methodologically this would be best studied using naturalistic inquiry, a qualitative analysis of what occurs in practice.

Ultimately ‘teaching models’ differ in terms of the degree of agency – freedom to act – given to and taken by the learner. Indeed, surgical educators ask themselves: What do I let my trainee(s) do/how much control do I want? How much feedback do I give on what they do? What do I draw their attention to, and what do I let them notice themselves? What norms and strategies do I make explicit, and which ones do I let them discover themselves? Educators can only answer these questions with reference to a specific moment in a concrete case, with a known learner and team. So, a teaching model is not a static, stable configuration – it is likely to change in different cases and even as a single operation progresses.

Knowles’ adult learning theory suggests that all educational efforts should be directed at and centred upon the learner, with past experience recognised and utilised [1]. However, wide differences have been found between surgical teachers and learners when reporting learner needs [2]. These differing perspectives may be as a result of threshold concepts [3], meaning that the surgical teacher cannot appreciate some of the challenges experienced by the learner.

Theory-based models of teaching in the operating theatre have foregrounded motor skills learning theory [4], with phases of learning marked as cognitive, integrative and autonomous [5, 6]. Other surgical educators have suggested that the postgraduate surgical trainee should be presented with a personalised and specific set of explicit objectives including a list of operations in which they should be competent at the end of the rotation [7].

Yet, despite its well-recognised importance as a venue for surgical learning, some have observed that there are long periods of time in the operating theatre

where seemingly no form of education takes place [8–10]. Additionally, there are wide differences between faculty and student perceptions of the quality and frequency of teaching in the operating theatre [11–15]. These discrepancies suggest that some learning is not recognised unless it is a direct result of explicit teaching strategies. Indeed, tacit knowledge has been acknowledged as important in allied specialties such as anaesthesia [16, 17] and is acquired through participation in a community of practice [18].

This chapter presents an evidence-based overview of what is known about content and process of teaching and learning in the operating theatre.

16.3 The Affordances of the Operating Theatre as an Educational Venue

The operating theatre poses unique challenges to the surgical educator as learning is integrated within patient care episodes and cannot be separated from it [19]. In many ways, the operating theatre is an ideal venue for surgical learning as the learning opportunities presented may be highly relevant and interesting to the postgraduate surgical learner – especially if the cases will constitute part of their eventual practice. Compared with learning in a classroom or an online learning platform, there are multiple different sensory stimuli, the environment is ‘real’ and there are opportunities for interaction with senior surgeons.

For a medical student, the operating theatre ‘presents an opportunity to observe real clinical problems and their surgical management [...] and to gain insight into the work of the surgeon as a member of a multi-professional team’ [20]. Additionally, there are multiple different stimuli for the learner. Lyon writes of the ‘sensual perceptual experience’ that is afforded to medical students, enabling them to construct a ‘clinical memory’ by integrating tactile sensations of live pathology with visual images and verbal learning [20, 21]. Dunnington et al. write about the high regard that students place upon teachers that allow the student to ‘feel’ the pathology [22].

16.4 The Challenges of the Operating Theatre as an Educational Venue

For the teacher:

Because the operating theatre is a work environment, the educator has limited ability to design specific learning episodes; they are restricted to the cases on the list that particular day. This means that the cases may not be appropriate to the stage of learning of the student and it may be difficult to ensure curriculum coverage over the course of the placement.

The surgical teacher also needs to manage the social relations of work with a cross-disciplinary team who may be from differing professional backgrounds to create a positive learning environment [22, 23].

The teaching surgeon has competing priorities in keeping the patient safe whilst educating their trainees, and this is especially important in the most critical portions of a surgery. Moulton et al. elaborated on some strategies inherent to teaching whilst avoiding surgical complications [24]. The teaching surgeons in their study maintained constant control, both over the progress of the entire surgery as well as individual steps. This required conducting a needs assessment of the trainee, encouraging the trainee to slow down during critical steps and sometimes taking over the surgery from the trainee. Some surgeons espoused the ability to give the trainee the illusion of control, although it was actually just the opportunity to operate under the teaching surgeon's guidance. They described a 'bargaining' between teacher and trainee, in which trainees were rewarded for preparation for the case by getting to operate more and sometimes punished for showing up unprepared.

For the learner:

The operating theatre can be an unwelcoming and intimidating environment for the medical student who needs to learn the explicated (e.g. in protocols) and tacit, implicit behavioural expectations and norms (the (local) 'culture'), e.g. norms about where to position themselves without de-sterilising the operative field [20, 21]. The high-stakes nature of surgical work can also have an emotional impact upon medical students as they may witness complications and tensions between members of the surgical team [25].

For undergraduate and postgraduate trainees, the nature of the work itself, the type of operation and high-stakes nature of it, complexity and timing of the procedure all affect the ability of the surgeon to allow intraoperative hands-on involvement, for example, allowing the postgraduate surgical trainee to perform the case under supervision [9, 26, 27]. There therefore may be limited opportunities for hands-on practice.

16.5 Structuring Operating Theatre Teaching

In terms of improving surgical education, it is increasingly recognised that experience alone is insufficient. For example, operating on carefully selected cases without direct supervision may be ineffective and inefficient and does not guarantee that learning is optimal or that learning opportunities are maximised [28]. Roberts et al. argue that a more deliberate approach to operating room teaching is needed in which objectives are set for learners' performance and immediate and specific feedback is provided to guide further practice [29]. It is hoped that in this way every surgical case includes a deliberate effort to improve a trainee's knowledge and skills. Roberts et al. put forward the briefing, intraoperative teaching and debriefing model (BID model) in the context of a surgical case making use of two events that bracket any

operation – scrubbing up and time spent closing – to discuss educational aims and objectives as well as an opportunity for reflection and reinforcement after the case [29].

Debriefing is a well-recognised strategy to facilitate learner reflection and to assist in ‘making every moment count’ [30] with regard to learning opportunities in the operating theatre. Debriefing strategies such as ‘SHARP: 5-step feedback tool for surgery’ provide a structured approach for the surgeon educator and has been shown to improve the quality of the educational feedback provided to the learner [31].

16.6 Content of Learning in the Operating Theatre

Whilst the theoretical perspectives in the introduction to this chapter foregrounded motor skills, we have also signposted that interpretations of tactile and visual cues are key aspects of learning to work with living tissues. Cope et al. describe learning in the operating theatre across six domains: ‘factual knowledge’, ‘motor skills’, ‘sensory semiosis’, ‘adaptive strategies’, ‘team-working and management’ and ‘attitudes and behaviours’ [32].

Some of these domains were thought to be prerequisites to being promoted to the role of primary surgeon. For example, postgraduate surgical learners were expected to know the anatomy, the steps of the operation and how to throw a surgical knot and take a clip on and off before they were invited to be the primary surgeon. In Lyon’s study, surgeons suggested that they are more likely to provide learning opportunities to those medical students that give off strong signs of motivation and commitment [21].

Cope et al. describe the learning of sensory semiosis – the ability of the surgical learner to make meaning of what he or she was seeing or feeling. They describe learning to interpret visual and haptic cues as learning how to *translate* what they were seeing into the ‘known’ anatomy of the textbook [32]. In the words of one of the trainees interviewed in this study:

[Y]ou need to be able to put your fingers into a small incision and know what you are feeling – like to be able to find the appendix through a tiny incision and more than that, you should be able to tell whether or not it is inflamed just by the feel. [32]

It is known that gaze patterns differ between novice and expert surgeons, in both simulated and real surgical environments, and theatre learning may involve learning to attend to and attribute meaning to specific aspects of the operative field [33, 34]. Ability to interpret visual and haptic cues within human tissues is not exclusive to surgery. In many clinical disciplines, making sense of information presented visually or by touch is an essential part of becoming a good diagnostician [35]. Clinicians examine patients looking for abnormal findings in the hands, face and skin that give pointers to the underlying diagnosis, the experienced clinician has learnt what ‘normal’ and ‘abnormal’ look and feel like.

16.6.1 *Verbal Intraoperative Teaching*

Intraoperative teaching requires verbal instruction and communication, and there is an increasing body of literature that has analysed verbal interactions between post graduate trainees and faculty in the operating theatre [36–39]. Verbal teaching has been parsed into multiple categorisations including ‘informing’, ‘explaining’, ‘commanding’, ‘quizzing’ and ‘banter’. Roberts et al. simplify these descriptive categories to:

Instrumental interaction – utilised to instruct the resident what action will move the case forward [38]. They termed this instrumental as the surgeon uses the learner like an instrument, as a means to an end.

[N]ow maybe if you grab right down... and pull that down and to the left there you go. Pull it up a little as well. [38]

Pure teaching interaction – intended primarily to benefit the learner through providing educational value. This usually necessitates a brief pause in the surgery.

[W]hen people start getting disease in the anal canal and the rectum, the chance of curing them is essentially nil, and the other issue there is that when people start having disease in their anal canal that their immune systems have been compromised in some way so then you have to consider the possibility of immunocompromise [38]

Instrumental and teaching interactions – intended to achieve the pragmatic goal of moving the case forward while also conferring teaching.

A little bit deeper. Get through, get through that, get that, see that? You see that white stuff there? That’s still dermis. We want to see fat, Okay let’s keep going up. [38]

Banter – conversation unrelated to the procedure.

Roberts et al. make a plea for noticing the ‘teachable moment’ intraoperatively. They describe this as an ‘unplanned learning opportunity that arises during the course of teaching’ in which the teacher has an opportunity to pair a teaching point with a current step of the surgery. This is especially powerful when an unexpected surgical event arises [38].

Quizzing was a specific teaching behaviour described by many authors in which the teaching surgeon uses Socratic style questioning to assess the surgical trainee’s knowledge [39].

Attending surgeon is discussing laparoscopic port placement while inserting a trocar through a lateral abdominal incision. As the port enters the abdominal wall, the attending asks the medical student, ‘Which vessel am I avoiding?’ Attending then proceeds to explain the relationship of the epigastric vessels to the port site. [39]

Quizzing is a well-recognised phenomenon in schools and colleges and will frequently follow the form of an Initiation, Response, Feedback/Evaluation (IRF/IRE) sequence [40, 41]. There is debate in the wider educational literature regarding the purpose and value of this type of teaching in which the questioner is already in possession of the answer but is using the opportunity to ‘test’ how closely the learner’s

answer matches their own version. Some would speculate that this form of teaching interaction may be primarily about exerting power and hierarchical relationships over the learner. Others argue that the tension experienced by the trainee during quizzing approximates the tension in a high-stakes surgery [42].

Verbal narratives are also used during intraoperative teaching to emphasise a variety of intraoperative teaching points [43]. Hu et al. relate that three types of story are told – practice changes from lessons learned, personal training stories and near misses and adverse events. The most commonly told types were practice changes from lessons learned, and these stories usually described parallel patients from which knowledge was gained and affected adjustments in the management of patients or personnel [43]. Personal training stories frequently communicated norms of surgical culture and professionalism.

16.6.2 Nonverbal Intraoperative Teaching

We have already outlined that learning to ‘feel the pathology’ is an important content domain of learning in the operating theatre, but touch and gesture are used for educational direction too. Chen et al. include pointing with instruments, finger or even laparoscopic camera within their taxonomy of surgeons’ guiding behaviours [44].

Sutkin et al. provide a fine-grained classification of physical actions and gestures used intraoperatively by surgeons to convey their meaning during teaching [45]. They categorise different forms of physical teaching guidance, such as ‘figurative’. This category refers to instances where the attending surgeon moves hands in space to describe the anatomy, the instrument or the motions required to accomplish a surgical step. They provide the following example:

Attending is directing resident how to use the LigaSure device to accomplish the next step. Attending gestures with his right hand in space towards Fellow “When you take the LigaSure, so you have the back side sealed”. His right hand flexes into a position similar to the hand position used to operate the handle of the LigaSure device. He makes this gesture after “LigaSure”. He beats with the back of his hand to the right, as if he is pushing something away, on “backside”. [45]

Because faculty assistance in the form of retraction, repositioning and scaffolding is an embedded form of surgical instruction, it can become difficult to categorise residents’ participation in operations as there are dynamic and fluid shifts of control throughout the operation [46]. It is often challenging to identify who is the primary operator. Because surgical trainees respond to the surgeon educator’s body movements and changes in hand and instrument positions, the surgical operation is a much more collaborative venture than perhaps would be thought by looking solely at verbal transcripts [47].

Some content areas of learning within the operating theatre are best delivered by specific educational strategies – for example, factual knowledge transmission may be best delivered through quizzing trainees with regard to anatomy and steps of the procedure. However, learning to interpret the feel of the tissues or how to interpret

visual cues in the tissue in order to find the correct plane for dissection may be best taught through collaborative strategies between the trainee and trainer [48].

Co-construction is a characteristic of teaching that has been observed in the operating theatre that can utilise both verbal and nonverbal instructional exchanges between trainer and trainee [47]. It is dialogic sequence between trainer and trainee as they ‘figure out’ the anatomy together. Whilst open surgery can afford access by pointing to structures to assist with meaning making, in laparoscopic surgery this can be difficult and there is on occasion an assumption that the intended audience knows what is referred to by ‘this’ or ‘that’ [45, 48]. In the following example, deictic words are underlined that correspond with the consultant pointing with the Maryland grasper and touching particular structures.

- Consultant:* Look at that
- Staff Grade:* It's it's weird. I would go into that space above
- Consultant:* That might be the artery and that might be the duct
Can you see this anatomy?
- Staff Grade:* Yep, ustYep, Just twisted twisted
- ST 7:* Yeah, it's really weird, it's twisting round each other
- Consultant:* Yeah, and what that's doing is it's, torting the Hartmann's, and what that's doing is it's, torting the Hartmann's pouch over
- Staff Grade:* Yeah, just move
- ST 7:* And you think behind where you are now, back
- Consultant:* This one?
- ST 7:* No, no. Back, back, back
- Consultant:* That?
- ST 7:* No, next one. Back, that?
- Staff Grade:* ThisThis is no, no maybe is no, no maybe
- Consultant:* That could be accessory artery?
- ST 7:* Do you think it's an accessory du
- ST 7:* Could be
- Consultant:* CouldCould be yeah be yeah

In this example, there is genuine co-construction of the anatomy at this part of the operation. The consultant, staff grade and trainee discuss this using verbal and non-verbal signs that stand for possible interpretations of what they are seeing and consider the different possibilities and hypotheses put forward. Co-construction sequences were found to end in ‘resolution’ when structures were assigned anatomical names or were discounted [48].

16.6.3 The Surgical Team

Of course, the operative team is much broader than just the teaching and training surgeons. Nurses, surgical technicians, anaesthesiologists and anaesthetists all interact with and have an impact on surgical learners. Team communication

influences a learner's sense of professional identity and the role of the surgeon within the team. Although surgeons, trainees and nurses often interpret interprofessional communication differently, the trainee who recognises that a senior nurse can be a good teacher in the operating theatre will increase their sense of professional identity [49].

16.6.4 Questions for Future Research

These intraoperative teaching episodes involve interesting discussions, but how do they impact surgical learning? There are multiple interesting questions ripe for future surgical education research, including: How does the briefing, intraoperative teaching and debriefing model (BID model) impact retention of new knowledge? What content about the hidden curriculum are within an attending's verbal narratives? What are the ideal ways to use retraction to orient the training surgeon to the next step of the surgery? How does an attending assess a trainee's position on the learning curve and make the surgical lessons succinct and appropriate? Does banter contribute to a safe learning environment? When quizzing makes a trainee uncomfortable, does that impact their performance? How is learning impacted by the pace of surgery? These questions are rich start points when considering current knowledge about intraoperative surgical teaching, and they deserve dedicated academic study. What content about the hidden curriculum are within an attending's verbal narratives? What are the ideal ways to use retraction to orient the training surgeon to the next step of the surgery? How does an attending assess a trainee's position on the learning curve and make the surgical lessons succinct and appropriate? Does banter contribute to a safe learning environment? When quizzing makes a trainee uncomfortable, does that impact their performance? How is learning impacted by the pace of surgery? These questions are rich start points when considering current knowledge about intraoperative surgical teaching and they deserve dedicated academic study.

16.7 Conclusions

This chapter aims to serve as an introduction to the evidence base around teaching and learning in the operating theatre. Teaching has been found to be highly complex involving many different team members along with sophisticated social interactions that include verbal and nonverbal guidance. The surgeon educator has both clinician and educator roles which must be managed simultaneously, which in part is what makes this a challenging educational venue. It is worth considering that the learner surgeon also observes these role conflicts and learns professional attributes of being a surgeon through the modelling of these behaviours.

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