

Teaching the Surgical Craft: Surgery Residents Perception of the Operating Theater Educational Environment in a Tertiary Institution in Nigeria

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ABSTRACT

Background: The transformation of a surgical trainee into a surgeon is strongly influenced by the quality of teaching in the operating theater. This study investigates the perceptions of residents about the educational environment of the operating theater and identifies variables that may improve the operating theater education of our trainees. **Materials and Methods:** Residents in the department of surgery anonymously evaluated teaching in the operating room using the operating theater education environment measure. The residents evaluated 33 variables that might have an impact on their surgical skills within the operating theater. The variables were grouped into four subscales; teaching and training, learning opportunities, operating theater atmosphere and workload/supervision/support. Differences between male and female residents and junior and senior registrars were assessed using Mann-Whitney test. Statistical analysis was completed with the statistics package for the social sciences version 17. **Results:** A total of 33 residents were participated in this study. Twenty nine (88%) males and 4 (12%) females. 30 (90%) were junior registrars. The mean total score was 67.5%. Operating theater atmosphere subscale had the highest score of 79.2% while workload/supervision/support subscale had the least score of 48.3%. There were significant differences between male and female resident's perception of workload/supervision/support $P < 0.05$; however, there was no significant differences in junior registrar versus senior registrar's perception of the education environment in all the subscales $P > 0.05$. **Conclusion:** This study has shown a satisfactory teaching environment based on the existing local realities of means, resources and tools and highlighted the need for improvement in workload/supervision/support in our institution. An acceptable learning environment in the operating theatre will produce surgeons that are technically competent to bridge the gap in the enormous unmet need for surgical care in Nigeria.

KEYWORDS: Teaching, operating theater, residents, perception, surgical craft

INTRODUCTION

The operating theater is a unique learning environment where surgical residents acquire technical skills, knowledge and

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confidence; the essentials of the craft of surgery.^[1,2] Surgical skills are learnt by trainees through an apprenticeship system, where consultants act as guides to trainees rotating through their units within a set period of time.^[3,4] A combination of teaching methods including supervised exposure to graded operative experience and didactic with feedback sessions imparts knowledge and technical skills.^[3,5-7] The challenge for the trainer has always been the translation of these tenets into practice.^[4]

Surgery is different compared with other medical disciplines as it requires the development of a physical craft with cognitive growth.^[1] Accuracy, speed, economy of effort and adaptability are determinants of surgical skill. Thus, coordination of actions, time and motion efficiency and the ability to provide assistance or make use of assistance appropriately are important factors in surgical handicraft.^[7] In addition, learning surgical procedures requires mental assimilation of new information and its accommodation with existing evidence based knowledge.^[8] Residents must take in myriads of information including, but not limited to selection of operation, patient positioning, anatomic and technical aspects of the operation and interaction with the operating theater team.^[9] Furthermore, the operating theater is often a stressful environment with a background of distractions.^[5] These include concerns about time management (e.g., patient cancellation), availability of resources (e.g., equipment allocation), roles (e.g., responsibilities), patient safety and sterility (e.g., aseptic

technique) and situation control (e.g., temperature regulation).^[5] Learning is thus shaped by the operating team, complexity of the case and the learning atmosphere.^[2] Suboptimal learning environments are undesirable and may significantly impact a trainee's perception and quality of learning. Positive learning environments have been associated with improved learner performance.^[8,10]

Surgical residents will spend > 10,000 h or over half of their clinical training experience in the operating room^[1] and will have less exposure to high volumes of surgical work than before for two reasons. First, in this era of operating theater efficiency, there is pressure to keep "turnover" in the operating room high, which allows less time for the consultant to teach and less opportunity for the trainees to learn and practice their skills. Secondly, patients with complex surgical problems that demand the skill of consultant surgeons working at maximum efficiency, increasingly populate our teaching hospitals.^[5] It is therefore increasingly important that opportunities for teaching in the operating theater be used as effectively as possible.^[1,3,11] This study investigates the perceptions of residents about the educational environment of the operating theater and identifies factors that may improve the operating theater educational experiences of our trainees.

MATERIALS AND METHODS

A survey of the education environment of the operating theater by residents in the department of surgery was carried out using the operating theater education environment measure questionnaire. The items in the questionnaire were adapted from those used by Kanashiro *et al.*^[12] Modifications were made to improve its suitability for the Nigerian context-questions relating to discrimination in the operating theater based on race and sex as well as questions on work hour restrictions and its impact on operative experience were excluded.^[12] Residents anonymously evaluated variables that might have an impact on their surgical skills within the operating theater. Each resident was instructed to refer to their most recent operating theater experience with a consultant surgeon. The survey was divided into 2 sections. Section 1 consisted of demographic information; age, sex and year of residency. Section 2 consisted of 33 Likert scale-response questions divided into 4 subscales; teaching and training (items 1-13); learning opportunities (items 14-22); operating theater atmosphere (items 23-27) and workload/supervision/support (items 28-33) [Appendix]. The inventory was scored according to the following method. For each statement, a score of 5 was given if the respondent indicated "strongly agree," 4 for "agree," 3 for "undecided," 2 for "disagree" and 1 for "strongly disagree." For the negative statements (8, 11, 14, 16, 19, 21, 24-26, 27-31 and 33) the scoring was reversed. Therefore, the maximum possible score for the 33-item inventory was 165 and the minimum possible score was 33. Based on a 5-point Likert non-parametric scale, a score of 3 was "undecided" and therefore corresponded to the 50th percentile; a score of 4 ("agree") corresponded to the 75th percentile; and a

score of 5 ("strongly agree") to the 100th percentile. Therefore, the educational environment was determined to be less than satisfactory by the respondents if any mean score was below 4 or 75%.^[8,12] An overall total score was then calculated for each respondent, as was a subtotal for each of the subscales. A reliability analysis (Cronbach alpha coefficient) was conducted on the whole inventory and for each subscale to determine internal consistency. The internal consistency was rated as positive if Cronbach's alpha was 0.7 (adequate) and 0.8 (excellent). A positive rating indicates that all items evaluate different aspects of the same construct.^[8] Differences between male and female residents and junior and senior registrars were assessed using Mann-Whitney test. Statistical analysis was completed with the statistics package for the social sciences version 17.

RESULTS

A total of 33 residents completed the questionnaires. Majority of the residents, 27 (82%), were between the ages of 30 and 39 years, with a mean age of 34.42 years. Gender was not evenly distributed, with 29 (88%) of the residents being male and 4 (12%) were female. Thirty (90%) of the residents were junior residents. The overall reliability or internal consistency of the questionnaire was an acceptable Cronbach coefficient of 0.811. Teaching and training subscale had the highest Cronbach coefficient of 0.722 while workload/supervision/support had the least Cronbach coefficient of 0.587 [Figure 1].

The mean total score was 67.5%. Teaching and training and operating theater atmosphere had the highest score of 74.8% and 79.2% respectively [Figure 2].

Analysis of subscale scores showed 6 items with satisfactory mean scores (mean item score > 4) in subscale teaching and training [Table 1]. Unsatisfactory mean scores (mean item score < 4) indicating a need for improvement were seen in all the subscales.

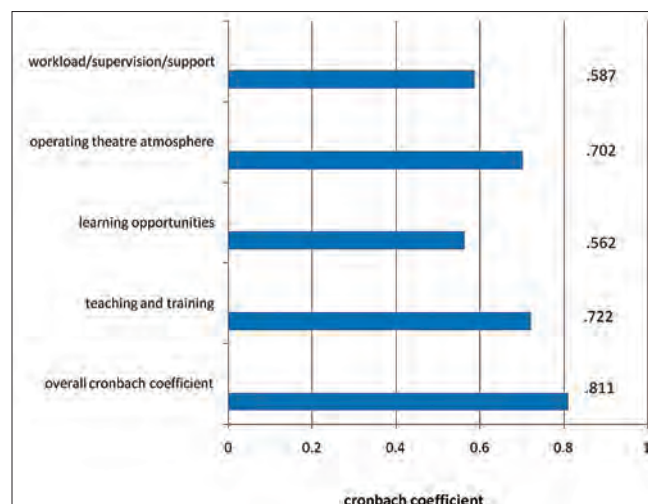


Figure 1: Overall cronbach coefficient and cronbach coefficient for each subscale

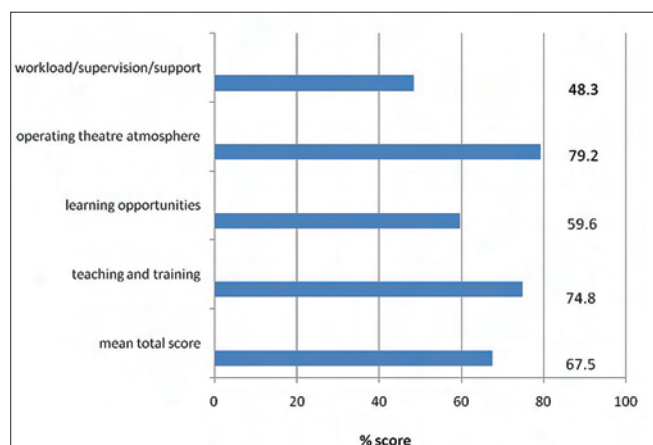


Figure 2: Mean percentage total score and percentage score for each subscale

The 3 lowest ranked scores in each of the subscales were;

Teaching and training: “Before the operation my consultant discusses the surgical technique planned,” “before the operation my consultant discusses what part of the procedure I will perform” and “my consultant gives me feedback on my performance” [Table 1].

Learning opportunities: [Table 2]. “There are too few cases on the elective list to give me the opportunity to operate,” “More senior residents or consultants take my opportunities to operate,” and “the number of emergency procedures is sufficient for me to gain the right operative experience.”

Operating theater atmosphere: “The nursing staff dislike it when I operate as the operation takes longer,” “the anesthetists put pressure on my consultant to operate himself to reduce anesthetist time” and “the atmosphere in the operating theatre is pleasant” [Table 3].

Workload/supervision/support: [Table 4]. “When I am in theatre, there is nobody to cover the ward,” “I am often too tired to get the most out of theatre teaching” and “the operative cases are too long.”

When analyzed for gender, there was a statistically significant difference on the subscale “workload/supervision/support” [Table 5]. This was corroborated by the statement no. 31, when I am in the operating theatre there is nobody to cover the ward.

Analysis by level of training revealed no statistical differences in overall scores between junior and senior residents.

DISCUSSION

The results of this study show that teaching and training subscales had satisfactory scores. This is encouraging given that the art of teaching can be a challenge under any circumstances. When the

Table 1: Responses to OTTEM survey questions: Subscale teaching and training

Teaching and training	Mean score
My consultant has a pleasant personality	4.18
I get on well with my consultant	4.18
My consultant is enthusiastic about teaching	4.12
My consultant has a genuine interest in my progress	4.12
I understand what my consultant is trying to teach me	4.18
My consultants surgical skills are very good	4.58
My consultant gives me time to practice my surgical skills in theatre	3.39
My consultant immediately takes the instruments away when I do not perform well	3.70
Before the operation my consultant discusses the surgical technique planned	3.30
Before the operation my consultant discusses what part of the procedure I will perform	3.20
My consultant expects my surgical skills to be as good as his/her	3.58
My consultant gives me feedback on my performance	2.90
My consultants criticism is constructive	3.75

OTTEM: Operating theater education environment measure

Table 2: Responses to OTEEM survey questions: Subscale learning opportunities

Learning opportunities	Mean score
The type of operations performed on this rotation are too complex for my level	3.91
The elective operating list has the right case mix to suit my training	3.50
There are too few cases on the elective list to give me the opportunity to operate	2.64
I get enough opportunity to assist	3.15
There are enough operating theater sessions per week for me to gain the appropriate experience	2.33
More senior residents or consultants take my opportunities to operate	2.50
The number of emergency procedures is sufficient for me to gain the right operative experience	2.42
My consultant is in too much of a rush during emergency cases to let me operate	3.06
I have the opportunity to develop the skills required at my stage	2.81

OTTEM: Operating theater education environment measure

Table 3: Responses to OTEEM survey questions: Subscale operating theatre atmosphere

Operating theatre atmosphere	Mean score
The atmosphere in the operating theater is pleasant	2.70
In the operating theater I don't like being corrected in front of medical students, nurses and residents	3.48
The nursing staff dislike it when I operate as the operation takes longer	2.06
The anesthetists put pressure on my consultant to operate himself to reduce anesthetist time	2.39
The staff in the operating theater are friendly	2.97

OTTEM: Operating theater education environment measure

teaching setting is within a busy surgery residency program, where consultants have to combine teaching responsibilities with patient

Table 4: Responses to OTEEM survey questions: Subscale workload/supervision/support

Workload/supervision/support	Mean score
I am often too tired to get the most out of theater teaching	2.87
I am so stressed in the operating theater that I do not learn as much as I should	3.16
I am asked to perform operations alone that I do not feel competent at	4.10
When I am in theater, there is nobody to cover the ward	2.10
The level of supervision in theater is adequate for my level	3.50
The operative cases are too long	3.15

OTEM: Operating theater education environment measure

Table 5: Comparison of perception of residents on individual subscales based on gender

Subscale	Gender	Number	Mean rank	P value
Teaching and training	Male	27	16.04	0.977
	Female	4	15.75	
Learning opportunities	Male	25	15.26	0.692
	Female	4	13.38	
Atmosphere	Male	26	14.96	0.425
	Female	4	19.00	
Workload/supervision/support	Male	27	14.74	0.046
	Female	4	24.50	

care, it becomes a lot of challenges.^[13,14] In addition, there are very limited established platforms within, which surgeons can learn to teach surgical skills, critically examine their teaching or evaluate its efficacy. Neither is there an accepted format for trainees in surgery to contribute their views about the teaching they receive.^[11] Evaluation of teaching by learners has been studied for decades; while research is divided learners have come to be regarded as a valid source of feedback on teaching. Residents are in close proximity to their consultants over extended periods of time and they are present on good as well as bad teaching days.^[13] The lowest scoring item in the teaching and training subscale is “my consultant gives me feedback on my performance.” The ultimate criterion of good teaching is learning. Consultants cannot improve their teaching in the operating theatre if they do not fully understand those teaching behaviors that support or discourage learning.^[14] In their landmark articles on teaching in the operating theatre, Vollmer *et al.*^[11] and Jeffree and Clarke^[15] emphasized several adult learning-based surgical teaching approaches to enhance feedback. Adult learners seek feedback on their performance thus; consultants must emphasize the attitude of giving feedback.^[11] If it is to be useful, feedback must be given in a non-threatening and constructive way. Negative, unconstructive feedback, such as humiliation and sarcasm, is a potent inhibitor of learning.^[16] Good feedback is empathetic; it describes actions and suggests alternative actions.^[1,15] In practice, this can be done by asking the trainee to identify what they did well, followed by positive comments from the consultant. The trainee is then asked to identify what could be improved and how, followed by the consultants suggestions. It is important to

emphasize the trainee’s strengths, not only to reduce the stress of the situation, but to reinforce these behaviors.^[15]

This study showed learning opportunities had an overall unsatisfactory score of 59%, suggesting the need for creating a supportive learning environment. The common theme in the perceived dissatisfaction of residents with learning opportunities is an inadequate “hands on” experience. We should sympathize with our trainees’ desire to practice their chosen craft and encourage them in their pursuit of knowledge and experience.^[17] Less than half of the residents agreed with the positively phrased statement “I have the opportunity to develop the skills required at my stage.” A defining feature of surgical training is the acquisition of procedural skills in the operating theater.^[10] It is important for consultants to assess each resident’s learning needs prior to going to the operating theater, identify knowledge gaps and ensure that their assumptions regarding resident’s knowledge are accurate.^[18] Van der Houwen *et al.*,^[19] agreed in their exploratory study on surgical training in the operating room. The study considered the triangle of trainer, trainee and context (including patient safety and time constraints). Their results suggest that trainers should present a plan of instruction, give trainees opportunities to operate and be supportive. The plan of instruction comprises a process of pre-operative, intra-operative and post-operative discussion. This model involves a specific protocol where consultants and residents spend a few minutes before a case in the operating theater (i.e., at the scrub sink) to jointly establish specific learning objectives (briefing). During the case, teaching and coaching by consultants deliberately focus on the pre-established learning objectives (intra-operative teaching). After the case, the resident is asked to reflect on his or her performance and attainment of stated learning objectives (debriefing).^[18,20] This type of learning approach provides some structure to operative teaching and allows the resident’s learning needs to be addressed while consultants have a platform for guided teaching and coaching.^[18]

Operating theater atmosphere had the highest subscale score in this study [Table 3]. However, the three lowest scoring items in this subscale, highlights two operating theatre behaviors that require modification to enhance the teaching environment: The need for a pleasant operating room atmosphere and advocacy with other staff to support teaching. Indeed, every study carried out on qualities of teachers valued by learners includes an observation that the consultant enjoys teaching and shows it through some sense of enthusiasm and that the teaching is carried out in a climate of mutual respect.^[14] This supports the notion that surgical skills are best communicated within the context of a non-threatening environment, in which the learner discerns a safety net, feels safe to perform tasks he or she has not yet mastered and anticipates effortless handling of unintended events. The consultant in such an operating atmosphere demonstrates composure, leadership and confidence.^[21,22]

In this study, female residents perceived workload/supervision/support as less favorable to their educational experience in

the operating theater. This is corroborated by the statement “when I am in the operating room, there is nobody to cover the ward” [Table 3]. This finding is not surprising since surgery is typically viewed as a very complex endeavor having an uncontrollable life-style with demands of both mental and physical endurance.^[23] Residents must demonstrate on a daily basis clinical competence in managing patients on the surgical ward and clinics while undertaking academic activities in the form of seminars, journal clubs, research and post-graduate review courses and examinations.^[17] All these collide with an overall deficit in the number of surgeons alongside an overwhelming surgical burden with advanced surgical pathology.^[24] This presents a perfect storm as demands for quality care from residents relates to surgical care.^[23,25] These impressions have likely contributed to the recently observed decreased interest in surgery by female medical students.^[26] The demands of surgery were once accepted without question by those entering surgical training, but they have more recently been viewed as impediments to having both a successful career and a rewarding family life.^[27] Professional advancement of women within surgery is improving, but there are still significant obstacles. To address these issues, it is important for consultant surgeons to model a balanced life-style and to promote it in surgical residents.^[26,27]

Level of training was analyzed by grouping junior residents and senior residents for comparison. Interestingly, the results suggests that junior residents’ global perception of learning was not adversely affected by having fewer learning opportunities, a higher workload or less supervision and support.^[8] This finding is at variance with the nature of their job description and their status on the learning hierarchy in the operating room.^[8] The junior residents are busier than the senior residents because they simultaneously cover the wards when in the operating room. On the ward, the junior residents are generally responsible for the daily ward duties, writing daily notes and orders. Senior registrars have a more supervisory role on the ward and perform administrative tasks such as organizing rounds and call-schedules.^[12] In the operating room junior registrars may assist and observe more procedures; senior registrars are expected to perform most surgical procedures with assistance.^[12] This finding suggests a strong homogeneity in personal characteristics,

which transcends the level of training. This similarity may be the result of a long self-sorting process that begins early in medical school for those who seek a career in surgery and increasingly, have or develop similar characteristics as grouping occurs through both medical school and the surgery residency program.^[28]

Previous studies have assessed the education environment of the theatre.^[10,12,29] Our study had a similar sample size with those done in Canada and Scotland [Table 6]. The Australian study had the largest sample size of 365 residents. All the studies demonstrated adequate internal consistency with Cronbach’s alpha > 0.7. Our study had similar subscale scores with the Canadian study; operating theatre atmosphere had the highest scores workload supervision and support had the lowest scores. Gender significant differences were observed in three studies. Our study had female scores higher than male scores. This was the reverse in the Canadian study. Discrepancies in the teaching environment based on existing local realities of means, resources and tools were not explored in all the studies. It however appears that the inventory originally adapted from the Scottish environment is relevant in all settings. The inventory measures tangible and potentially modifiable aspects affecting teaching and learning in the most unique and important venue for training surgical residents - the operating theatre. Perhaps the most promising outcome of these studies is the potential application to teaching in the operating theatre. It would supplement the work of surgical education researchers who have identified important characteristics of the daunting task of effective teaching.^[30,31]

Some limitations need to be considered in the interpretation and application of the results of this study. First, this research was completed at a single institution using a convenient sample of surgery residents attending the weekly morbidity and mortality meeting. Thus generalization may be compromised as the potential for selection bias has to be taken into consideration. The study should be replicated in more tertiary institutions to glean a larger sample size of residents to generalize the results. A second weakness is the nature of the subject population-surgical residents. There is a lack of perspective of the trainers – consultants. For a complete view of the educational environment of the theatre, their opinion should be included. Future research is required to

Table 6: Comparison of OTEEM scores in 3 countries

Study (year)	Sample size	Overall cronbach coefficient	Teaching and training (mean score/ cronbach coefficient)	Learning opportunities (mean score/ cronbach coefficient)	Operating theatre atmosphere (mean score/ cronbach coefficient)	Workload/supervision/support (mean score/ cronbach coefficient)
Kanashiro <i>et al.</i> ^[12] 2006 (Canadian inventory)	22	0.866	73% (0.864)	73% (0.731)	78% (0.589)	68% (0.628)
Cassar 2004 (Scottish inventory)	26	0.877	79% (0.842)	67% (0.589)	76% (0.574)	75% (0.569)
Adam Mahoney <i>et al.</i> 2010 (Australian inventory)	365	N/A	72% N/A	72% N/A	78% N/A	75% N/A

OTTEM: Operating theater education environment measure

compare the perceptions of consultants and residents. Third, this is a self-report survey research. While surveys are commonly used for needs assessments the results are heavily dependent on the content and context of the questionnaire^[32] and the results must be considered from this standpoint.

CONCLUSION

We believe our study is an accurate portrayal of the operating theater education environment in our institution. It shows a satisfactory teaching environment and highlights the need for improvement in workload/supervision/support. An acceptable learning environment in the operating theatre will produce surgeons that are technically competent to bridge the gap in the enormous unmet need for surgical care.

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APPENDIX: OPERATING THEATER EDUCATION ENVIRONMENT MEASURE

Your participation in this questionnaire will be anonymous. Please refer to your most recent operating theater experience with a consultant surgeon.

Section 1

- Age
- Sex
- Year of residency

Section 2

Please answer the following questions by indicating whether you:

- Strongly agree-SA
 - Agree-A
 - Undecided-U
 - Disagree-DA
 - Strongly disagree-SD
1. My consultant has a pleasant personality
 2. I get on well with my consultant
 3. My consultant is enthusiastic about teaching
 4. My consultant has a genuine interest in my progress
 5. I understand what my consultant is trying to teach me
 6. My consultant's surgical skills are very good
 7. My consultant gives me time to practice my surgical skills in theatre
 8. My consultant immediately takes the instruments away when I do not perform well
 9. Before the operation my consultant discusses the surgical technique planned
 10. Before the operation my consultant discusses what part of the procedure I will perform
 11. My consultant expects my surgical skills to be as good as his/her
 12. My consultant gives me feedback on my performance
 13. My consultant's criticism is constructive
 14. The type of operations performed on this rotation is too complex for my level
 15. The elective operating list has the right case mix to suit my training
 16. There are too few cases on the elective list to give me the opportunity to operate
 17. I get enough opportunity to assist
 18. There are enough operating theatre sessions per week for me to gain the appropriate experience
 19. More senior residents or consultants take my opportunities to operate
 20. The number of emergency procedures is sufficient for me to gain the right operative experience
 21. My consultant is in too much of a rush during emergency cases to let me operate
 22. I have the opportunity to develop the skills required at my stage
 23. The atmosphere in the operating theatre is pleasant
 24. In the operating theatre I don't like being corrected in front of medical students, nurses and residents
 25. The nursing staff dislikes it when I operate as the operation takes longer
 26. The anesthetists put pressure on my consultant to operate himself to reduce anesthetist time
 27. The staff in the operating theater is friendly
 28. I am often too tired to get the most out of theatre teaching
 29. I am so stressed in the operating theatre that I do not learn as much as I should
 30. I am asked to perform operations alone that I do not feel competent at
 31. When I am in theater, there is nobody to cover the ward
 32. The level of supervision in theater is adequate for my level
 33. The operative cases are too long.

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