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Quality Assurance Of Operating Room-Based Learning: Development & Validation Of 'Surgical Operating Room Educational Experience Measure' For Medical Students (SOREEMST)

Jahangeer Ahmad, Talat Waseem, Zaitoon Zafar, Rizwan Qaiser Danish

INTRODUCTION Operating Room (OR) based learning experience has traditionally remained challenging owing to complex medical, psychosocial, educational and administrative factors and, so is its measurement of success. Recently, mini-STEEM, an abbreviated form of Surgical Theater Educational Experience Measure (STEEM) has been employed to evaluate the OR-based learning experience of medical students. However, its content and construct validity has been challenged, in light of updated extensive literature review, justifying the need for a more robust, reliable and content valid instrument.

METHODS Extensive literature review was done to identify and evaluate various factors affecting students' OR based learning within the OR setting and a conceptual framework was developed. Artino et al's (AMEE Guide 87) seven-step approach was used to develop and validate this new instrument, which has been named Surgical Operating Room Educational Experience Measure (SOREEMST). Content Validity Index (I-CVI) was measured, with a range between 0.68-1 for all items. Following principles of Structural Equation Modeling (SEM) and piloting on 535 students, Exploratory Factor Analysis (EFA) was carried out to finally retain 50 items for subsequent model fitness in Confirmatory Factor Analysis (CFA) through SPSS-AMOS 24.

RESULTS Against previously identified 26 constructs, 100 items were initially designed and expert-validated for clarity, relevance and comprehension. Cognitive interviews were done to optimize item clarity and comprehension, and finally the items were piloted on a pool of 536 students. Reliability and internal consistency were analyzed through Cronbach's alpha and exploratory factor analysis (EFA) to refine and choose final 50 items for SOREEMST. Which model best fit to conceptual framework was confirmed through Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM).

CONCLUSIONS SOREEMST is a reliable, novel, content/construct valid instrument to assess the quality of the OR based learning experience of medical students and may be used to quality assure the OR-based learning process.

KEY WORDS Operating Room; Operation Theater; Learning; Student; Resident; Quality of Learning Experience; Structured Learning; STEEM; mini-STEEM; SOREEMST

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The Operating Room (OR) provides a real-life opportunity to understand the dynamics of surgical care and learning, however, the process of learning and teaching within this continuously evolving environment still remains challenging for both, the surgical educator and the medical student.[1, 2] Resident learning within the OR setting pins around the principles of apprenticeship model and self-directed learning that follows Lyon's Model and Knowle's principle of andragogy.[3, 4] These models provide a reasonable outcome in terms of resident training; however, the dynamics of medical students' learning remain quite disparate, un-structured and opportunistic. Consequently, medical students do not benefit greatly by applying the same principles of teaching and learning as do the surgical residents. Many emotional, socio-environmental, organizational factors and factors related to educational relevance and surgical educator play a role in this realm.[2,5,6] The quality of learning within the OR and the quality assurance of this learning has long been a subject of scientific enquiry and debate.

Nagraj et al have previously proposed an instrument, mini-STEEM, to assess the quality of student learning within OR environment, which is an abbreviated form of Kevin Cassar's Surgical Theater Educational Environment Measure (STEEM). [7, 8] STEEM is a reliable, content valid instrument for resident training. [7, 8] Mini-STEEM, on the contrary, although reliable with Cronbach's alpha value of 0.82, does not

assess all domains which pertain to medical students' learning experiences within the OR setting. We have recently identified various limitations within mini-STEEM which pertain to its content and construct validity.6 This necessitates the development of a new instrument which encompasses all the domains of the student learning within OR setting as identified recently.[1, 2, 6] The objective of this study is to develop an improved, reliable and content valid instrument which comprehensively evaluates various aspects of the medical student's OR based learning.

METHODS

Following ethical approval from local institutional review board, the study was conducted according to Artino et al's AMME Guide 87.[9] Seven steps were followed and the sequence of the components of the study have been highlighted in Figure 1.

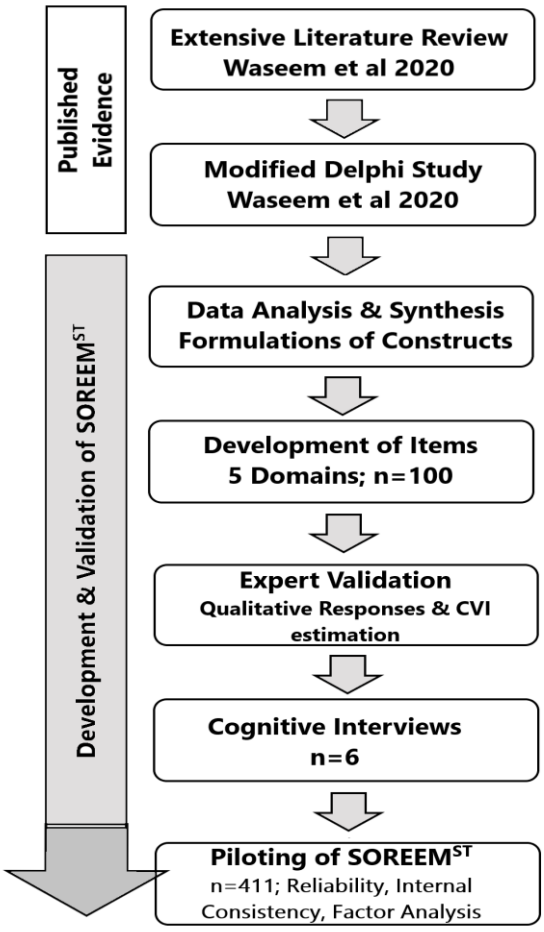

Figure 1: Flow Chart describing the components of study and instrument development

Initially, following PRISMA flow chart (highlighted previously in Waseem et al, 2020) the literature search was done through PubMed, ERIC and Google Scholar (described in detail previously, Waseem et al). Thematic analysis and review were performed to identify the factors influencing OR based student learning. Additionally the review consisted of analysis of various models available for OR based learning which pertain to the medical students' learning in the OR and various scales currently being used to assess the medical student's OR based learning. [7, 8, 10, 11, 12, 13] Students were qualitatively assessed in terms of their perceptions and thoughts about their OR based learning through a previously conducted Delphi based analysis and 26 different constructs were identified which in varying proportions affect student's OR based learning[6] (Table 1).

Themes (5)	Subthemes (26)	
STRUCTURED LEARNING PROCESS (Structured Course /Lesson Planning, Content Selection, Delivery, Assessment & Administration)	1.	Structured or Opportunistic OR learning
	2.	Content Selection, delivery, assessment and their alignment to essential aspects of graduate learning
	3.	Designing and Communicating Learning Objectives for OR learning should be mandatory
	4.	Clarity of Learning Objectives
	5.	Feasibility of learning objectives to be realistically achievable
	6.	Synchronization of the learning objectives with rest of the teaching.
	7.	Importance of Personal Learning Objectives in OR Learning
	8.	Optimal student-teacher interaction & opportunities for equal participation promote OR learning experience
QUALITY OF THE FACULTY & TRAINING (Educator Related Factors)	1.	Interest of educator
	2.	Importance of educator's behaviour and attitude
	3.	Competency of educator
	4.	Importance of teaching style
	5.	Importance of teacher's preparedness
ORGANIZATIONAL SUPPORT	1.	Significance of OR orientation session.
	2.	Importance of environmental readiness
	3.	Synchronization simulation / Lab activities with OR lessons
	4.	Importance of adequate visualization in student learning
PSYCHOSOCIAL MANAGEMENT & TRAINING (Psychosocial Factors)	1.	Impact of anxiety in OR environment
	2.	Effect of fear, intimidation or victimization in OR learning environment
	3.	Impact of feeling welcome in OR
STUDENT'S SELF-REGULATION, MOTIVATION & PARTICIPATION (Student Related Factors)	1.	Ability to self-regulate learning in OR
	2.	Impact of student motivation
	3.	Impact of self confidence
	4.	Student's Prior Knowledge & Pre-lesson self-review of reading material
	5.	Student's Readiness to participate
	6.	Student's Focus on Practice

Table 1: Factors Affecting Student Learning within OR Setting: Extracted Themes & Subthemes

These factors were content validated in terms of clarity, comprehension and relevance.

Structural Equation Modeling (SEM) is an extended analytical technique of General Linear Modeling and regression analysis where we can test many equations simultaneously but it also enables modeling of errors and many dependent variables in one go. SEM takes confirmatory approach to data analysis rather than exploratory approach[14, 15] which can incorporate observed and unobserved variables simultaneously. Factor analysis is the best known procedure to test the relationship between a set of latent and observed variables. When the link between observed and latent variables is uncertain, we use EFA and determine factor loadings of various factor[14], of course, parsimoniously as less as possible.

Based on these 26 constructs 100 items were initially designed (Table 1). These items were expert validated by 8 experts in terms of clarity, relevance and comprehension (Table 2). Cognitive interviews were done with 8 students to judge their perspective about the proposed items with concurrent prompting. The study was piloted among 535 students to assess its reliability, internal consistency through Cronbach alpha estimation and through exploratory factor analysis (EFA) (Appendix 1) and confirmatory factor analysis (CFA). Based on EFA finally 50 items were chosen to include in SOREEMST and the model confirmation done through SEM (Appendix 1).

All statistical analysis was done in SPSS and SPSS AMOS 24. Cronbach alpha estimation was done for reliability and internal consistency. Content validity index was measured as described previously.[16]

RESULTS

To identify various factors influencing student's OR-based learning extensive literature reviews have been done.[2, 17] We have also previously done an updated extensive literature review and have prioritized various factors based on their relative importance.[6] Based on these previous studies we did literature synthesis and identified 26 constructs under 5 domains (Table1) (Previously published, Waseem et al 2020). Against these constructs, 100 questionnaire items (Table 2) were developed as described by Artino et al previously.[9] These items were subjected to expert validation through qualitative means and through estimation of content validity index (I-CVI) as described previously.[16] Table 2 describes CVI for each item in column 3. Respondent item-suitability was judged through cognitive interviews and finally the piloting was done on the students. The SOREEMST scores were estimated for various domains of OR-based learning experience as shown in Table 2. In this study we generated a pool of 100 items and ran EFA (Appendix 1) where items were deleted that have loadings less than 0.30 as suggested by Hu and Bentler or their presence reduces the reliability of construct or they have negative covariance or high errors residual covariances.[18] Then Confirmatory Factor Analysis was run in AMOS 26 (Figure 2),The results of which are given in Table 3.

The results show that retained items have factor loadings greater than 0.40 except Q3 which has factor loadings 0.359. As samples size is large enough (N=535) so we can retain this item with less loading. Cronbach Alpha, Composite Reliabilities and Average variance extracted for convergent Validity which are all higher than threshold value (>0.50) is given in this table. Composite reliability is the measure of internal consistency better than Cronbach Alpha (which relies on parallelity or equal loadings of variables) which should be greater than the benchmark of 0.7 to be considered adequate.19 Here all the values are higher. Based on the EFA and Model fitness 50 items were selected for the SOREEMST which have been described in Appendix 2.

DISCUSSION

Medical student's learning experience is unique, differs from a resident's learning perspective and is multifactorial.[2] Previously, experts in this area identified and prioritized various intermediary items, which regulate learning process and quality outcomes. Many factors related to structured learning process, organization, educator, student and psychosocial domains determine the quality of overall learning experience in the OR setting. Previously, mini-STEEM which is an abbreviated version of STEEM, has been used to assess the quality of the OR learning process. Recently, its content validity has been challenged, considering expanding dimensions of the OR learning process.

There is a growing body of literature which directs and indicates the expanding role of structured learning process despite difficulties of its implementation within the OR setting. The structured learning process involves careful course/ lesson planning, delivery process and assessment involving the psychomotor and affective components apart from the cognitive portion of the operative learning. Similarly, the educator related and student related factors significantly influence the learning process within the OR setting. Teacher's interest, competence, style and welcoming attitude are independent predictors of quality OR learning. Faculty training in this regard can be pivotal. This also provides better student-body management within the OR setting. Student's interest, receptive attitude, capacity to self-regulate learning and social handling within the OR can alter the outcomes of OR learning process. Organizational support in terms of providing adequate technology and administrative support has additive value. Psychosocial training of the faculty and the students can have positive effect on improving quality of learning process.

Item	Item Description	Expert Validation I-CVI estimation	Piloting (n=535) Mean Score	SD
1	My teaching and learning in operating room are well-planned and organized	0.94	4.806	.5153
2	My teacher follows the lesson-plans delivered to us at start of the session	0.79	4.813	.5108
3	I am on my own for my learning within operating room	0.73	1.579	1.1647
4	Content selection for OR sessions is done in coordination with students at my institution	0.91	4.716	.8620
5	The content taught in OR sessions is relevant	0.84	4.811	.5119
6	The OR learning sessions contain right mix of elective surgical cases	0.79	4.464	1.2505
7	I also get opportunity to experience emergency cases in operating room apart from elective cases	0.84	4.475	1.2508
8	Preoperative and postoperative care are a part of my learning within OR setting	0.70	4.497	.5005
9	Lessons are taken in preoperative area to teach preoperative care of patient	0.79	4.473	1.2507
10	My teachers provide a meaningful commentary while performing a surgical procedure	0.92	4.779	.6534
11	My teacher explains the anatomical background of each step while performing surgery	0.91	4.714	.8625
12	Running commentary about the surgical procedure keeps me engaged	0.86	4.811	.5119
13	Lessons are taught in postoperative area to teach postoperative care	0.93	4.495	1.2053
14	My teacher discusses the theoretical background of the surgery in the post op class to strengthen my concepts	0.87	4.720	.8611
15	My teachers conduct follow-up classes after the surgical procedure to clarify my concepts and queries	0.91	4.493	1.2053
16	Number of sessions that I undergo in OR are optimal for my required level of learning	0.83	4.462	1.2504
17	The lessons in operating room address my practical skills	0.85	4.471	1.2507
18	My OR lessons are exam-oriented	0.99	4.710	.8634
19	I am also tested about practical skills apart from theoretical knowledge in OR lessons	0.85	4.460	1.2504
20	I get a constructive feedback about my OR learning performance	0.99	4.708	.8639
21	My teachers provide learning objectives of the planned lesson prior to its delivery.	0.92	4.822	.5049
22	Provision of learning objectives prior to lesson keeps me focused	0.85	4.781	.6526
23	My teachers teach at large as per availability of the operative cases in OR	0.91	4.705	.8648
24	My teachers teach at large in operating room as the opportunity of learning arises	0.82	4.495	.5004
25	The learning objectives provided to me about the OR session are clear and understandable.	0.99	4.800	.5186
26	My OR lessons are planned according to the stated learning objectives	0.87	4.789	.6493
27	I am taught in OR what my teacher wishes to teach	0.93	4.718	.8616
28	The learning objectives of the OR sessions are realistic and feasible	0.86	4.495	1.2053
29	OR lesson planning is done according to the available resources at my institution	0.85	4.456	1.2503
30	My OR learning objectives conform to available provisions at my institution	0.84	4.505	1.2053
31	My teachers teach me in OR in line with lessons being taught in the rest of curriculum	0.87	4.469	1.2506
32	Lessons of simulation lab and the OR activities are synchronized to logically enhance my learning	0.91	4.477	1.2508
33	The lessons in operating room fit with my existing understanding about the topics being taught	0.91	4.467	1.2506
34	I have my own personal learning objectives for the OR sessions	0.77	3.574	1.1242
35	In busy OR environment, I try to learn things on my own	0.69	3.576	1.1257
36	I go through learning material on my own beforehand, in accordance with the planned surgical procedures	0.79	3.587	1.1348
37	My learning in OR is not being affected by number of students within my batch rotating for OR lessons	0.88	1.579	1.1647
38	My class size in OR is optimal for my learning	0.97	4.495	1.2053
39	The students in my batch rotating in operation theatre have ample and equal opportunities for learning	0.98	4.495	.5004
40	When we enter Operating room, it becomes too crowded	0.71	3.583	1.1318
41	Equal participation of students is ensured during OR sessions	0.84	4.032	.7867
42	My teacher is quite enthusiastic about my learning in OR	0.98	4.507	1.2053
43	My teacher is more focused on his work than teaching me in OR sessions	0.88	1.675	1.1767
44	My teacher takes optimal interest in my learning in OR sessions	0.72	4.779	.6704
45	My teacher's behaviour in OR sessions is quite supportive for my learning	0.78	4.075	.8108
46	My teacher is quite helpful for me in OR sessions	1	4.503	1.2053
47	My teacher encourages my learning in OR sessions	0.84	4.707	.8643
48	My teachers in OR are quite friendly and welcoming and easy to share with	0.81	4.710	.8634
49	In OR setting I am welcomed for learning	0.79	4.505	1.2053
50	I have trouble asking questions or sharing my views in OR	0.91	1.751	1.1929
51	My teacher is quite competent in teaching OR lessons	0.79	4.695	.8669
52	My teacher has a good grip on content of OR lessons	0.91	4.794	.6468
53	I am not comfortable with teaching competency of my teacher in OR	0.82	1.593	1.1970
54	I like my teacher's teaching style in OR sessions	0.89	4.720	.8611
55	Teaching style of my teachers in OR conforms to my needs	0.82	4.469	1.2506
56	My teacher adapts different learning styles to meet the needs of lesson	0.84	4.456	1.2503
57	My teacher is adequately prepared for my OR lessons	1	4.503	1.2053
58	My teacher is usually unprepared for OR lessons	0.81	1.679	1.1857
59	My teacher prepares environment in OR conducive for	0.71	3.574	1.1242

	our learning			
60	My teachers conduct orientation session within OR prior to starting lessons	0.8	4.821	.5061
61	I did not have any orientation session in OR prior to start of lessons	0.8	1.654	1.2354
62	OR orientation session at beginning of my rotation was quite helpful for me	0.98	4.787	.6501
63	My institution is keen to facilitate us in terms of infrastructure and administrative issues that we face while learning in OR	0.98	4.725	.8596
64	Our operating rooms are well equipped with gadgets to aid our learning	0.79	4.499	1.2053
65	Theatre administration is difficult to reach for issues related to my learning in OR	0.84	1.757	1.2058
66	My operation theatre complex is equipped with modalities important for my learning in OR	0.86	4.710	.8634
67	My lessons within simulation and skill labs align well with my teaching in OR	0.89	4.507	1.2053
68	My OR learning activities conform to my learning opportunities in simulation lab	0.83	4.471	1.2507
69	My lesson-plan in simulation lab is unrelated to OR learning activities	0.87	1.675	1.1767
70	I find it difficult to observe operative procedures adequately	0.86	4.047	.7954
71	LED screens, microphones and additional measures have been provided to improve our visualization of the surgical procedure	0.85	4.510	1.2052
72	Our institution has special arrangements to improve visualization of operative procedures for the students	0.9	4.497	1.2053
73	OR environment is quite friendly	0.89	4.774	.6558
74	Neither me or my friend feel intimidated by any staff member in OR setting	0.79	4.712	.8630
75	I feel anxious in OR setting	0.82	1.680	1.1901
76	I am discriminated in OR sessions because of my race.	0.93	1.589	1.1879
77	I am discriminated in OR sessions because of my sex	0.86	1.632	1.1823
78	I am discriminated in OR setting based on my religion	0.91	1.572	1.1457
79	I can question to my teachers freely	0.86	4.815	.5096
80	I feel being victimized in operating room	0.91	1.641	1.2048
81	I feel welcomed in OR sessions	0.69	4.800	.6442
82	The staff in operating theatre is friendly and supportive	0.95	4.779	.6534
83	I feel myself as part of the team when I enter the theatre	0.83	4.512	1.2052
84	Within busy routines of operating room, I can self-regulate my learning	0.89	3.561	1.1132
85	Despite non-supportive circumstances, I am able to significantly learn during the OR session	0.93	4.492	1.2053
86	In OR setting, it is important to plan my learning on my own	0.88	3.572	1.1226
87	My motivation level is high during OR sessions	0.76	3.564	1.1164
88	My enthusiasm controls my learning in OR setting.	0.72	3.572	1.1226
89	My OR learning is proportional to my interest in OR	0.82	4.811	.5119
90	My self-confidence affects my overall learning in the operating room	0.77	4.492	1.2053
91	I feel confident and it positively affects my academic performance in OR	0.82	4.464	1.2505
92	Non-judgmental teaching style improves my confidence	0.85	4.785	.6510
93	My overconfidence may affect negatively in learning process	0.75	4.695	.8669
94	I am well-prepared by watching procedure videos and reading material prior to having OR lessons	0.88	4.712	.8630
95	My prior knowledge affects my overall learning in OR	0.82	4.475	1.2508
96	My prior skills affect my overall learning in OR	0.77	4.462	1.2504
97	I am adequately receptive for learning within OR environment	0.90	4.488	1.2052
98	My OR learning is proportional to my receptiveness for learning	0.76	4.779	.6534
99	I focus on repetition of surgical skills in simulation lab and OR	0.8	3.578	1.1272
100	My focus on repetition of skills improves quality of learning in simulation lab and OR	0.94	4.512	1.2052

Table 2: SOREEMST Expert Validation and Scores based on 5 domains identified through literature review.

SOREEMST is a comprehensive instrument to evaluate medical student's learning experience in the OR setting and evaluates all potential dimensions of students' OR based learning process. Its content validity has been expert validated. High Cronbach's alpha and good factor loading for each item are testament for its quality assured structure. It has been employed in our local cohort of the students to assess the quality of learning.

This instrument, however, has it's limitations; it is quite lengthy and may exhaust respondents. Similarly, it has been piloted only in a single institution and its external validity and generalizability still needs to be explored. Additionally, we tried to explore the relationship of 26 constructs identified through SEM, however, this added greatly to the complexity of model and model fits failed. Despite this limitation, the expert validity and strong association of the five identified themes gives great strength to the conceptual model.

In conclusion, SOREEMST is a detailed instrument to evaluate the quality of the learning process within the OR setting. It comprehensively evaluates all domains of the learning process within the OR setting and the quality of the education experience. It may be useful for quality assurance of OR based student learning at an institutional level, and may also be used to determine the quality of OR based learning experiences as more and more structured clinical encounters are designed for the enriched learning experience within operating room.

Items/Themes			Factor Loadings	Critical Ratio	P	Composite Reliability	Average Reliability	Cronbach Alpha
Quality of Faculty & Training	<---	**QUALITY_OF_OR LEARNING_EXPERIENCE**	.997	94.435	***			
Organizational Support	<---	**QUALITY_OF_OR LEARNING_EXPERIENCE**	.994	89.507	***			
Psychosocial Factors	<---	**QUALITY_OF_OR LEARNING_EXPERIENCE**	.735	22.994	***			
Student's Self-regulation, Motivation & Participation	<---	**QUALITY_OF_OR LEARNING_EXPERIENCE**	.999	94.435	***			
Structured Learning Process	<---	**QUALITY_OF_OR LEARNING_EXPERIENCE**	.998	22.052	***			
Q1	**<---**	**Structured Learning Process**	**.695**	**Fixed**		**0.986**	**0.768**	**0.981**
Q3	<---	Structured Learning Process	.359	8.251	***			
Q4	<---	Structured Learning Process	.774	17.522	***			
Q5	<---	Structured Learning Process	.704	15.987	***			
Q6	<---	Structured Learning Process	.979	21.918	***			
Q7	<---	Structured Learning Process	.979	21.913	***			
Q9	<---	Structured Learning Process	.980	21.924	***			
Q10	<---	Structured Learning Process	.679	15.442	***			
Q13	<---	Structured Learning Process	.985	22.033	***			
Q14	<---	Structured Learning Process	.775	17.543	***			
Q15	<---	Structured Learning Process	.986	22.060	***			
Q16	<---	Structured Learning Process	.979	21.910	***			
Q17	<---	Structured Learning Process	.979	21.908	***			
Q18	<---	Structured Learning Process	.773	17.499	***			
Q33	<---	Structured Learning Process	.979	21.912	***			
Q20	<---	Structured Learning Process	.771	17.462	***			
Q21	<---	Structured Learning Process	.713	16.196	***			
Q25	<---	Structured Learning Process	.690	15.685	***			
Q28	<---	Structured Learning Process	.986	22.048	***			
Q30	<---	Structured Learning Process	.987	22.073	***			
Q32	<---	Structured Learning Process	.979	21.916	***			
Q38	<---	Structured Learning Process	.984	22.025	***			
Q82	**<---**	**Psychosocial_ Management & Training**	**.957**	**Fixed**		**0.906**	**0.599**	**0.910**
Q79	<---	Psychosocial_ M & T	.911	41.194	***			
Q78	<---	Psychosocial_ M & T	.551	14.702	***			
Q77	<---	Psychosocial_ M & T	.541	14.336	***			
Q76	<---	Psychosocial_ M & T	.533	14.073	***			
Q74	<---	Psychosocial_ M & T	.865	34.501	***			
Q73	<---	Psychosocial_ M & T	.958	51.837	***			
Q72	**<---**	**Organizational Support**	**.988**	**Fixed**		**0.968**	**0.835**	**0.962**
Q71	<---	Organizational Support	.989	108.588	***			
Q67	<---	Organizational Support	.988	105.731	***			
Q64	<---	Organizational Support	.989	106.945	***			
Q63	<---	Organizational Support	.778	28.025	***			
Q60	<---	Organizational Support	.713	23.201	***			
Q57	**<---**	**Quality of Faculty & Training**	**.988**	**Fixed**		**0.964**	**0.800**	**0.955**
Q56	<---	Quality of Faculty & Training	.976	84.445	***			
Q51	<---	Quality of Faculty & Training	.770	27.324	***			
Q50	<---	Quality of Faculty & Training	.400	10.033	***			
Q49	<---	Quality of Faculty & Training	.988	103.512	***			
Q46	<---	Quality of Faculty & Training	.988	104.908	***			
Q42	<---	Quality of Faculty & Training	.987	102.832	***			
Q100	**<---**	**Student's Self-regulation, Motivation & Participation**	**.984**	**Fixed**		**0.969**	**0.798**	**0.965**
Q98	<---	Student's Self-regulation, Motivation & Participation	.683	21.343	***			

Q96	<---	Student's Self-regulation, Motivation & Participation	.980	85.315	***
Q95	<---	Student's Self-regulation, Motivation & Participation	.979	84.736	***
Q94	<---	Student's Self-regulation, Motivation & Participation	.778	27.969	***
Q91	<---	Student's Self-regulation, Motivation & Participation	.979	84.545	***
Q89	<---	Student's Self-regulation, Motivation & Participation	.701	22.452	***
Q85	<---	Student's Self-regulation, Motivation & Participation	.984	90.919	***

Table 3: Factor Loadings, Reliabilities and Average Variance Extracted

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Appendix 1:

Exploratory Factor Analysis and Item Selection

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1. My teaching and learning in operating room are well-planned and organized	418.94	3848.854	.813	.983
2. My teacher follows the lesson-plans delivered to us at start of the session	418.93	3849.340	.812	.983
3. I am on my own for my learning within operating room	419.32	3829.803	.485	.983
4. Content selection for OR sessions are done in coordination with students at my institution	419.03	3809.093	.857	.983
5. The content taught in OR sessions are relevant	418.93	3849.233	.812	.983
6. The OR learning sessions contain right mix of elective surgical cases	419.28	3756.007	.936	.982
7. I also get opportunity to experience emergency cases in operating room apart from elective cases	419.27	3756.649	.932	.982
8. Preoperative and postoperative care are a part of my learning within OR setting	419.24	3909.710	-.142	.983
9. Lessons are taken in preoperative area to teach preoperative care of patient	419.27	3756.474	.933	.982
10. My teachers provide a meaningful commentary while performing a surgical procedure	418.96	3836.152	.797	.983
11. My teacher explains the anatomical background of each step while performing the surgery	419.03	3809.057	.857	.983
12. Running commentary about the surgical procedure keeps me engaged	418.93	3849.285	.811	.983
13. Lessons are taught in postoperative area to teach postoperative care	419.25	3759.437	.948	.982
14. My teacher discusses the theoretical background of the surgery in the post op class to strengthen my concepts	419.02	3809.228	.857	.983
15. My teachers conduct follow-up classes after the surgical procedure to clarify my concepts and queries	419.25	3759.210	.950	.982
16. Number of sessions that I undergo in OR are optimal for my required level of learning	419.28	3755.865	.937	.982
17. The lessons in operating room address my practical skills	419.27	3756.498	.933	.982
18. My OR lessons are exam-oriented	419.03	3808.750	.859	.983
19. I am also tested about practical skills apart from theoretical knowledge in OR lessons	419.28	3755.915	.937	.982
20. I get a constructive feedback about my OR learning performance	419.03	3808.606	.860	.983
21. My teachers provide learning objectives of the planned lesson prior to its delivery.	418.92	3849.733	.815	.983
22. Provision of learning objectives prior to lesson keeps me focused	418.96	3836.274	.796	.983
23. My teachers teach at large as per availability of the operative cases in OR	422.45	3995.139	-.867	.984
24. My teachers teach at large in operating room as the opportunity of learning arises	422.24	3892.968	.126	.983
25. The learning objectives provided to me about the OR session are clear and understandable.	418.94	3848.755	.809	.983
26. My OR lessons are planned according to the stated learning objectives	418.95	3836.723	.795	.983
27. I am taught in OR what my teacher wishes to teach	422.46	3994.500	-.865	.984
28. The learning objectives of the OR sessions are realistic and feasible	419.25	3759.344	.949	.982
29. OR lesson planning is done according to the available resources at my institution	419.29	3755.733	.938	.982
30. My OR learning objectives conform to available provisions at my institution	419.24	3759.844	.946	.982
31. My teachers teach me in OR in line with lessons being taught in the rest of curriculum	419.27	3756.412	.933	.982
32. Lessons of simulation lab and the OR activities are synchronized to logically enhance my learning	419.27	3756.637	.932	.982
33. The lessons in operating room fit with my existing understanding about the topics being taught	419.27	3756.245	.935	.982
34. I have my own personal learning objectives for the OR sessions	420.17	3905.728	-.042	.983
35. In busy OR environment, I try to learn things on my own	421.32	3898.801	.007	.983
36. I go through learning material on my own beforehand, in accordance with the planned surgical procedures	420.16	3906.202	-.045	.983

37. My learning in OR is not being affected by number of students within my batch rotating for OR lessons	422.16	3974.856	-.512	.984
38. My class size in OR is optimal for my learning	419.25	3759.486	.948	.982
39. The students in my batch rotating in operation theatre have ample and equal opportunities for learning	419.25	3909.639	-.141	.983
40. When we enter Operating room, it becomes too crowded	421.33	3898.448	.009	.983
41. Equal participation of students is ensured during OR sessions	419.71	3897.255	.033	.983
42. My teacher is quite enthusiastic about my learning in OR	419.24	3759.888	.945	.982
43. My teacher is more focused on his work than teaching me in OR sessions	419.42	3824.524	.516	.983
44. My teacher takes optimal interest in my learning in OR sessions	418.96	3833.950	.803	.983
45. My teacher's behaviour in OR sessions is quite supportive for my learning	419.67	3899.395	.010	.983
46. My teacher is quite helpful for me in OR sessions	419.24	3759.688	.947	.982
47. My teacher encourages my learning in OR sessions	419.04	3808.435	.861	.983
48. My teachers in OR are quite friendly and welcoming and easy to share with	419.03	3808.649	.860	.983
49. In OR setting I am welcomed for learning	419.24	3759.904	.945	.982
50. I have trouble asking questions or sharing my views in OR	419.49	3823.235	.518	.983
51. My teacher is quite competent in teaching OR lessons	419.05	3807.899	.864	.983
52. My teacher has a good grip on content of OR lessons	418.95	3836.892	.796	.983
53. I am not comfortable with teaching competency of my teacher in OR	419.33	3829.305	.475	.983
54. I like my teacher's teaching style in OR sessions	419.02	3809.157	.858	.983
55. Teaching style of my teachers in OR conforms to my needs	419.27	3756.356	.934	.982
56. My teacher adapts different learning styles to meet the needs of lesson	419.29	3755.699	.938	.982
57. My teacher is adequately prepared for my OR lessons	419.24	3759.722	.946	.982
58. My teacher is usually unprepared for OR lessons	419.42	3824.267	.514	.983
59. My teacher prepares environment in OR conducive for our learning	420.17	3905.717	-.042	.983
60. My teachers conduct orientation session within OR prior to starting lessons	418.92	3849.814	.812	.983
61. I did not have any orientation session in OR prior to start of lessons	419.40	3825.022	.488	.983
62. OR orientation session at beginning of my rotation was quite helpful for me	418.96	3836.552	.796	.983
63. My institution is keen to facilitate us in terms of infrastructure and administrative issues that we face while learning in OR	419.02	3809.432	.857	.983
64. Our operating rooms are well equipped with gadgets to aid our learning	419.24	3759.518	.948	.982
65. Theatre administration is difficult to reach for issues related to my learning in OR	419.50	3823.015	.514	.983
66. My operation theatre complex is equipped with modalities important for my learning in OR	419.03	3808.634	.860	.983
67. My lessons within simulation and skill labs align well with my teaching in OR	419.24	3759.929	.945	.982
68. My OR learning activities conform to my learning opportunities in simulation lab	419.27	3756.501	.933	.982
69. My lesson-plan in simulation lab is unrelated to OR learning activities	422.07	3980.411	-.544	.984
70. I find it difficult to observe operative procedures adequately	421.79	3905.489	-.051	.983
71. LED screens, microphones and additional measures have been provided to improve our visualization of the surgical procedure	419.23	3760.145	.944	.982
72. Our institution has special arrangements to improve visualization of operative procedures for the students.	419.24	3759.519	.948	.982
73. OR environment is quite friendly	418.97	3836.027	.795	.983
74. Neither me or my friend feel intimidated by any staff member in OR setting	419.03	3808.793	.859	.983
75. I feel anxious in OR setting	422.06	3980.597	-.539	.984
76. I am discriminated in OR sessions because of my race.	419.33	3829.368	.478	.983
77. I am discriminated in OR sessions because of my sex	419.37	3826.036	.503	.983
78. I am discriminated in OR setting based on my religion	419.31	3830.171	.491	.983
79. I can question to my teachers freely	418.93	3849.409	.813	.983
80. I feel being victimized in operating room	419.38	3825.653	.496	.983
81. I feel welcomed in OR sessions	418.94	3837.324	.794	.983
82. The staff in operating theatre is friendly and supportive	418.96	3836.291	.795	.983
83. I feel myself as part of the team when I enter the theatre	419.23	3760.249	.943	.982
84. Within busy routines of operating room, I can self-regulate my learning	420.18	3905.063	-.038	.983
85. Despite non-supportive circumstances, I am able to significantly learn during the OR session	419.25	3759.091	.951	.982
86. In OR setting, it is important to plan my learning on my own	420.17	3905.527	-.041	.983
87. My motivation level is high during OR sessions	420.18	3905.184	-.038	.983

88. My enthusiasm controls my learning in OR setting	420.17	3905.561	-.041	.983
89. My OR learning is proportional to my interest in OR.	418.93	3849.188	.813	.983
90. My self-confidence affects my overall learning in the operating room	419.25	3759.207	.950	.982
91. I feel confident and it positively affects my academic performance in OR	419.28	3756.029	.936	.982
92. Non-judgmental teaching style improves my confidence	418.96	3836.393	.797	.983
93. My overconfidence may affect negatively in learning process	419.05	3807.940	.863	.983
94. I am well-prepared by watching procedure videos and reading material prior to having OR lessons	419.03	3808.793	.859	.983
95. My prior knowledge affects my overall learning in OR	419.27	3756.560	.932	.982
96. My prior skills affect my overall learning in OR	419.28	3756.026	.936	.982
97. I am adequately receptive for learning within OR environment	419.25	3759.006	.951	.982
98. My OR learning is proportional to my receptiveness for learning	418.96	3836.186	.796	.983
99. I focus on repetition of surgical skills in simulation lab and OR	420.16	3905.823	-.043	.983
100. My focus on repetition of skills improves quality of learning in simulation lab and OR	419.23	3760.151	.944	.982

Appendix 2

Surgical Operating Room Educational Experience Measure for students—SOREEM[ST]

Name:		**Age/ Sex:**	
Year of Education		**I**nstitution	
Date			

Questionnaire Items (50)	Strongly Disagree	Partially Disagree	Neutral	Agree	Strongly Agree
1. My teaching and learning in operating room are well-planned and organized	①	②	③	④	⑤
2. I am on my own for my learning within operating room	①	②	③	④	⑤
3. Content selection for OR sessions is done in coordination with students at my institution	①	②	③	④	⑤
4. The content taught in OR sessions are relevant	①	②	③	④	⑤
5. The OR learning sessions contain right mix of elective surgical cases	①	②	③	④	⑤
6. I also get opportunity to experience emergency cases in operating room apart from elective cases	①	②	③	④	⑤
7. Lessons are taken in preoperative area to teach preoperative care of patient	①	②	③	④	⑤
8. My teachers provide a meaningful commentary while performing a surgical procedure	①	②	③	④	⑤
9. Lessons are taught in postoperative area to teach postoperative care	①	②	③	④	⑤
10. My teacher discusses the theoretical background of the surgery in the post op class to strengthen my concepts	①	②	③	④	⑤
11. My teachers conduct follow-up classes after the surgical procedure to clarify my concepts and queries	①	②	③	④	⑤
12. Number of sessions that I undergo in OR are optimal for my required level of learning	①	②	③	④	⑤
13. The lessons in operating room address my practical skills	①	②	③	④	⑤
14. My OR lessons are exam-oriented	①	②	③	④	⑤
15. I get a constructive feedback about my OR learning performance	①	②	③	④	⑤
16. My teachers provide learning objectives of the planned lesson prior to its delivery.	①	②	③	④	⑤
17. The learning objectives provided to me about the OR session are clear and understandable.	①	②	③	④	⑤
18. The learning objectives of the OR sessions are realistic and feasible	①	②	③	④	⑤
19. My OR learning objectives conform to available provisions at my institution	①	②	③	④	⑤
20. Lessons of simulation lab and the OR activities are synchronized to logically enhance my learning	①	②	③	④	⑤
21. The lessons in operating room fit with my existing understanding about the topics being taught	①	②	③	④	⑤
22. My class size in OR is optimal for my learning	①	②	③	④	⑤

23. My teacher is quite enthusiastic about my learning in OR	①	②	③	④	⑤
24. My teacher is quite helpful for me in OR sessions	①	②	③	④	⑤
25. In OR setting I am welcomed for learning	①	②	③	④	⑤
26. I have trouble asking questions or sharing my views in OR	①	②	③	④	⑤
27. My teacher is quite competent in teaching OR lessons	①	②	③	④	⑤
28. My teacher adapts different learning styles to meet the needs of lesson	①	②	③	④	⑤
29. My teacher is adequately prepared for my OR lessons	①	②	③	④	⑤
30. My teachers conduct orientation session within OR prior to starting lessons	①	②	③	④	⑤
31. My institution is keen to facilitate us in terms of infrastructure and administrative issues that we face while learning in OR	①	②	③	④	⑤
32. Our operating rooms are well equipped with gadgets to aid our learning	①	②	③	④	⑤
33. My lessons within simulation and skill labs align well with my teaching in OR	①	②	③	④	⑤
34. LED screens, microphones and additional measures have been provided to improve our visualization of the surgical procedure	①	②	③	④	⑤
35. Our institution has special arrangements to improve visualization of operative procedures for the students	①	②	③	④	⑤
36. OR environment is quite friendly	①	②	③	④	⑤
37. Neither me or my friend feel intimidated by any staff member in OR setting	①	②	③	④	⑤
38. I am discriminated in OR sessions because of my race.	①	②	③	④	⑤
39. I am discriminated in OR sessions because of my sex	①	②	③	④	⑤
40. I am discriminated in OR setting based on my religion	①	②	③	④	⑤
41. I can question to my teachers freely	①	②	③	④	⑤
42. The staff in operating theatre is friendly and supportive	①	②	③	④	⑤
43. Despite non-supportive circumstances, I am able to significantly learn during the OR session	①	②	③	④	⑤
44. My OR learning is proportional to my interest in OR	①	②	③	④	⑤
45. I feel confident and it positively affects my academic performance in OR	①	②	③	④	⑤
46. I am well-prepared by watching procedure videos and reading material prior to having OR lessons	①	②	③	④	⑤
47. My prior knowledge affects my overall learning in OR	①	②	③	④	⑤
48. My prior skills affect my overall learning in OR	①	②	③	④	⑤
49. My OR learning is proportional to my receptiveness for learning	①	②	③	④	⑤
50. My focus on repetition of skills improves quality of learning in simulation lab and OR	①	②	③	④	⑤