

Evaluation of the anaesthetic theatre educational environment at the University of the Witwatersrand

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Background: The educational environment impacts various aspects of students' professional development and well-being and is an important aspect of medical education programmes. Limited research investigating the theatre educational environment has been identified in South Africa. This study aims to describe the educational environment in theatre for registrars in the Department of Anaesthesiology at the University of the Witwatersrand (Wits).

Methods: A prospective, descriptive study design was followed, involving anaesthetic registrars at Wits, using the adapted Anaesthetic Theatre Educational Environment Measure (ATEEM) questionnaire between April and June 2019. A convenience sampling method was implemented to administer the anonymous questionnaire. Categorical variables were described using numbers and percentages. Descriptive statistics were used to calculate the total scores. The independent t-test or analysis of variance test was used to make comparisons.

Results: A total of 85 (78.7%) anaesthetic registrars participated in this study. The mean total (SD) adapted ATEEM score was 116.5 (16.9) out of a total of 164. The total scores for male and female registrars were 118.4 (13.5) and 115.3 (18.7) respectively ($p = 0.419$). First-year registrars scored 121.6 (14.3), second years 111.1 (19.0), third years 111.4 (14.6) and fourth years 122.3 (18.7) ($p = 0.003$). Junior and senior registrars scored 117.1 (17.0) and 115.7 (17.1) respectively ($p = 0.708$). The three hospitals were scored 112.3 (19.5), 119.8 (16.4) and 115.4 (12.0) respectively ($p = 0.187$). The mean scores for the five domains were autonomy 25.4/32 (3.1), perception of atmosphere 31.6/44 (5.4), workload/supervision/support 17.3/28 (3.5), perception of teachers and teaching 14.3/20 (2.9), and learning opportunities and orientation to learning 27.9/40 (5.1).

Conclusion: The theatre educational environment is perceived as more positive than negative, but with room for improvement. With the availability of a validated instrument to assess the educational environment quantitatively, regular quality assessments of the educational environment should be included in the training institution's practice.

Keywords: anaesthetic theatre educational environment, anaesthesiology registrars, education environment

Background

Anaesthesiology is a branch of medicine involved with the care of surgical patients before, during and after surgery, as well as the management of pain.¹ Training to become an anaesthesiologist is one of the many domains of postgraduate medical education that can be pursued. The World Federation for Medical Education (WFME)² defines postgraduate medical education as "the phase in which doctors develop competencies under supervision towards independent practice after completion of their basic medical qualification". The objective of any postgraduate medical education programme is to produce specialists who can provide the highest quality of care to their patients.²

An important development in medical training programmes since the year 2000 has been the move towards competency-based education – "the notion that an expert physician is defined by a broad set of identified competencies".³ Many competency frameworks that outline these core competencies have been developed. Examples of these include the Accreditation Council for Graduate Medical Education (ACGME) in the United States of America,⁴ Canadian Medical Education Directives for Specialists (CanMEDS),⁵ and Tomorrow's Doctor in the United Kingdom.⁶

These frameworks have been adopted and adapted by countries all over the world.³

One of the most important factors determining the acquisition of the identified competencies by the different frameworks is the quality of the training programme. It is for this reason that the WFME has shown a great deal of interest in the assessment and improvement of education programmes. The WFME has identified the educational environment as a factor that plays a pivotal role in the quality of postgraduate education programmes.² A good educational environment is therefore critical to successful postgraduate training.^{7,8}

According to the American Medical Association,⁹ the educational environment is "a social system that includes the learner (including the external relationships and other factors affecting the learner), the individuals with whom the learner interacts, the setting(s) and purpose(s) of the interaction, and the formal and informal rules/policies/norms governing the interaction".

How the educational environment is perceived is important because an environment that is conducive to learning is considered to be a learning agent that stimulates the learning process¹⁰ and the accomplishment of goals and objectives¹¹

necessary for quality and successful postgraduate training.^{7,8} The link between the educational environment and the quality of the education programme illustrates the need for training institutions to become more accountable for ensuring the necessary supportive educational environment for their trainees by regularly performing quality assessments of the educational environment.¹¹

Many instruments have been developed over the years to help with assessments of the educational environment of teaching programmes, but only a few instruments specifically assess the quality of the unique educational environment in the hospital setting.¹² These instruments include the Dundee Ready Education Environment Measure (DREEM),¹³ the Postgraduate Hospital Educational Environment Measure (PHEEM),¹⁴ the Surgical Theatre Educational Environment Measure (STEEM)¹⁵ and the Anaesthetic Theatre Educational Environment Measure (ATEEM).¹⁶

The medical and educational literature has shown that the quality of the educational environment plays a role in effective learning,¹⁶ quality training^{7,8} career satisfaction,^{17,18} academic achievements,^{18,19} burnout rates,²⁰ and the levels of engagement and motivation.²¹⁻²³ Anaesthesiology registrars spend most of their time in theatre, and this is a unique educational environment in which most of their training occurs. The ATEEM is a specific instrument for the measurement of the anaesthetic theatre educational environment.¹⁶

Limited research investigating the anaesthetic theatre educational environment has been identified internationally^{16,24,25} and in South Africa. The quality of the theatre educational environment for anaesthesiology registrars at the University of the Witwatersrand (Wits) is yet to be explored quantitatively. However, in light of the fact that a supportive learning environment is fundamental to the professional development, moral development and well-being of anaesthetic trainees, this educational environment needs to be assessed to ultimately ensure a quality postgraduate medical education programme that produces competent specialists that provide the safest and highest quality of care to patients.

This study aimed to describe the educational environment in theatre for anaesthesiology registrars in hospitals allied to the Department of Anaesthesiology at Wits.

Methods

A prospective, contextual, descriptive research design was followed in this study. The study was conducted in the Department of Anaesthesiology, affiliated to the Faculty of Health Sciences of Wits in Johannesburg, South Africa. The staff complement of the department is 74 consultants, 108 registrars and 22 medical officers. Three of the hospitals on the academic training platform were included in this study; two are central hospitals and one is a tertiary hospital. These hospitals were labelled A, B and C.

The study population consisted of all registrars who were willing to participate and had completed at least three months of registrar training in the Department of Anaesthesiology at Wits. A junior registrar was defined as one who had completed more than three months but less than two years of training, and a senior registrar as one who had completed two or more years of training. A convenience sampling method was used. The sample size was realised by the response rate. A minimum response rate of 60% (65 participants) was considered acceptable.²⁶

The study tool was an adapted version of the ATEEM questionnaire which was developed by Holt and Roff.¹⁶ Permission to use and to adapt the ATEEM questionnaire was granted by Roff.

The original ATEEM questionnaire consists of 40 items. The original questionnaire was adapted, in consultation with an anaesthesiologist with expertise and experience in medical education, to contextualise it to the South African environment. The adaptation included one further item, asking about the presence of racial discrimination, that was added to the perception of atmosphere domain of the original ATEEM questionnaire. The reason for this is that racial discrimination remains an ongoing problem in South Africa. According to a survey conducted in 2015, the majority of South African citizens (56%) believe that they are treated unequally by employers due to race.²⁷

The adapted ATEEM questionnaire used in this study had a total of 41 items pertaining to the theatre educational environment. The data for this study were collected at academic meetings between April and June 2019 with the anonymous self-administered questionnaire. The adapted ATEEM questionnaire assessing the theatre educational environment of the most recent training hospital where the participant had completed a three-month general rotation took approximately 20 minutes to complete. Upon completion, the questionnaires were folded and placed in a sealed box at the exit of the meeting venue.

The level of agreement with each statement was rated using a 5-point Likert scale ranging from "Strongly agree" to "Strongly disagree". The 41 items were clustered into five domains. These domains were autonomy (8 items), perception of atmosphere (11 items), workload, supervision and support (7 items), perceptions of teachers and teaching (5 items), and learning opportunities and orientation to learning (10 items).

Data were entered into a Microsoft Excel spreadsheet and were analysed using the statistical program STATA (StataCorp, USA) version 15. Each of the 41 items which form part of the questionnaire was allocated a score ranging from 0 to 4 based on the level of agreement with each statement. The Likert scale and scoring system that were used in the previous studies utilising the ATEEM instrument were used in this study for comparison of results. Three of the 41 items (4, 24 and 41) were negative statements and reversed scoring was applied to these items. A maximum score of 164 was possible for the questionnaire. Categorical variables were described using numbers and percentages. The total score was reported on an interval scale.

The interval scale was as follows:

0–41	Very poor educational environment
42–82	Plenty of problems with the educational environment
83–123	More positive than negative, but there is room for improvement
124–164	Excellent educational environment ¹⁴

The score for each of the five domains was also calculated and reported using an interval scale which placed the total score into one of four categories (very poor, plenty of problems, more positive than negative but with room for improvement, and excellent). To determine the range of scores that formed each category, the total score possible for each domain was divided into four equal portions.

Incomplete questionnaires were excluded from the study. The data were normally distributed and described using means and standard deviations. Comparisons between junior and senior registrar scores, and between the scores of male and female registrars, were done using the independent t-test. Comparisons between the scores for each year of training, and between the scores for the different hospitals were done using analysis of variance (ANOVA) and Tukey's test was performed if required. A *p*-value of < 0.05 was considered statistically significant. The internal reliability of the instrument was measured using Cronbach's alpha coefficient. A Cronbach's alpha of 0.7 or more was considered an acceptable internal reliability measurement.²⁸

Results

At the time of data collection, all 108 registrars had completed more than three months of training. A total of 105 questionnaires were distributed during the data collection period. Three registrars were inaccessible during the time of data collection. A total of 90 (85.7%) questionnaires were returned. Five (4.8%) questionnaires were excluded due to being incomplete, and therefore 85 (81%) questionnaires were included in the study, representing 78.7% of anaesthetic registrars in the department.

The characteristics of the respondents are listed in Table I.

The Cronbach's alpha for the questionnaire was calculated to be 0.935. According to George and Mallery's²⁸ rule of thumb, this indicated an excellent internal reliability of the instrument.

The mean total (SD) adapted ATEEM score for all respondents was 116.5 (16.9) out of a total of 164. The distribution of all the adapted ATEEM scores obtained is shown in Table II.

Table I: Characteristics of respondents

Characteristic	n (%)
Sex	
Male	32 (37.6)
Female	53 (62.4)
Year of training	
1st	27 (31.8)
2nd	20 (23.5)
3rd	23 (27.1)
≥ 4th	15 (17.6)
Hospital at which a three-month rotation was last completed	
A	28 (32.9)
B	41 (48.2)
C	16 (18.8)

Table II: Distribution of adapted ATEEM scores of respondents

Description of the theatre educational environment	n (%)
Very poor educational environment	0 (0)
Plenty of problems with the educational environment	2 (2.4)
More positive than negative but room for improvement	57 (67.1)
Excellent educational environment	26 (30.6)

The score for each domain of the questionnaire is illustrated in Table III.

The autonomy domain was assessed as being excellent (scoring between 25 and 32) while all the other domains were assessed as more positive than negative, but with room for improvement.

Comparisons between the total adapted ATEEM score according to sex, seniority, year of training and hospital are illustrated in Table IV.

The scores of the first- and fourth-year registrars showed a statistically significant difference compared to the second- and third-year registrars after performance of the Tukey's test, with the former scoring significantly higher.

Further comparisons of the total scores for each domain of the questionnaire between the different hospitals were performed. These results are illustrated in Table V.

Hospital A scored the lowest for the domains of autonomy, perception of atmosphere, and perception of teachers and teaching. Hospital C scored the lowest for the domains of

Table III: Score for each domain of the questionnaire

Domain	Maximum score possible	Mean score	SD	Score percentage (%)
Autonomy	32	25.4	3.1	79.4
Perception of atmosphere	44	31.6	5.4	71.8
Workload, supervision and support	28	17.3	3.5	61.8
Perception of teachers and teaching	20	14.3	2.9	71.5
Learning opportunities and orientation to learning	40	27.9	5.1	69.8

Table IV: Adapted ATEEM score comparison between characteristics

Characteristic	n (%)	Mean (SD)	p-value
Sex			
Male	32 (37.6)	118.4 (13.5)	0.419
Female	53 (62.4)	115.3 (18.7)	
Seniority			
Junior	47 (55.3)	117.1 (17.0)	0.708
Senior	38 (44.7)	115.7 (17.1)	
Year of training			
1st	27 (31.8)	121.6 (14.3)	0.003
2nd	20 (23.5)	111.1 (19.0)	
3rd	23 (27.1)	111.4 (14.6)	
4th	15 (17.6)	122.3 (18.7)	
Hospital at which a three-month rotation was last completed			
A	28 (32.9)	112.3 (19.5)	0.187
B	41 (48.2)	119.8 (16.4)	
C	16 (18.8)	115.4 (12.0)	

Table V: Adapted ATEEM score for each domain at the different hospitals

Domain	Hospital			p-value
	A	B	C	
Autonomy	25.0	25.6	25.5	0.748
Perception of atmosphere	29.7	32.2	33.5	0.050
Workload, supervision and support	16.9	18.0	15.9	0.124
Perception of teachers and teaching	13.0	15.3	14.4	0.004
Learning opportunities and orientation to learning	27.7	28.8	26.1	0.199

learning opportunities and orientation to learning, and for workload, supervision and support.

A statistically significant difference was observed between the perception of teachers and teaching domain at Hospital A and Hospital B after performing the Tukey's test.

The results for the question pertaining to racial discrimination are illustrated in Table VI.

Table VI: Scores for racial discrimination in the training post

Presence of racial discrimination	n (%)
Strongly agree	5 (5.9)
Agree	13 (15.3)
Neutral	38 (44.7)
Disagree	19 (22.4)
Strongly disagree	10 (11.8)

Discussion

This study found that the anaesthetic theatre educational environment at Wits was perceived as more positive than negative, but with room for improvement. No other South African study evaluating the educational environment quantitatively could be identified.

A qualitative study²⁵ in 2017 analysing registrars' experience of their training concluded that overall the Wits Department of Anaesthesiology was a positive place in which to learn, similar to the findings of this study.

Three international studies that used the ATEEM instrument in the United Kingdom (UK),¹⁶ which is a developed country, and in Pakistan²⁴ and Iran,²⁹ which are developing countries, were used to discuss the findings of this study. From the Pakistani study²⁴ only the public sector scores were used, as training of the respondents at Wits takes place only in the public sector. To make comparisons more valid, the mean total ATEEM score in this section was calculated after removing item 41, this study's adaptation of the ATEEM.

The mean total ATEEM score of this study after removal of the adaptation was 114 out of 160 and this score was comparable to the studies in the UK,¹⁶ Iran²⁹ and the public sector of Pakistan²⁴ with scores of 117, 114 and 109, respectively. The mean total score for all three studies fell into the same category of more positive than negative, but with room for improvement.

When comparing the scores of the domains of the ATEEM between this study and the studies in Iran²⁹ and Pakistan,²⁴ all three studies had the same highest and lowest scoring domains. Autonomy was the highest scoring domain, while workload, supervision and support was the lowest scoring domain. This illustrates that anaesthetic trainees in developing countries encounter similar factors that promote or inhibit a conducive anaesthetic theatre educational environment.

The domains of autonomy and learning opportunities and orientation to learning of this study scored higher than in the three international studies.^{16,24,29} A possible reason for the higher scoring of the autonomy domain is the level of responsibility given to trainees in the South African health system and the accountability for the care given to patients.³⁰ With regard to the learning opportunities and orientation to learning domain, the patient load with varieties of pathology allows for workplace-based learning and the opportunity for exposure to a large number and variety of practical procedures.³¹

The workload, supervision and support domain of this study scored lower than the three international studies.^{16,24,29} The possible reasons for this domain scoring lowest are the increased patient loads and the staff shortages in the South African public hospitals.³²

This study, the Pakistani study²⁴ and the Iranian study²⁹ found no statistically significant difference in the scores based on the sex of the respondents. The study conducted in the UK did not analyse differences in scores between male and female respondents. The overall educational environment appears to be similarly experienced by both male and female respondents.

Similar to this study, the study conducted in the UK¹⁶ found differences in scores between the different years of registrar training. This study, as well as the UK study, found a drop in the scores between the first and second registrar training years. In

both studies, the second year of registrar training scored the lowest when compared to the first, third and fourth years. In contrast to this study, there was a significant improvement in scores from respondents in their third year, with the third year of registrar training scoring the highest in the UK study. In this study, the scores between the second and third years were similar and a significant improvement was seen from third- to fourth-year scores, resulting in the fourth year of registrar training scoring the highest. No reasons were provided for these possible differences in scores observed in the UK study.

The differences in this study could be attributed to a few possible causes, based on anecdotal evidence. Firstly, registrars in their first year receive more direct supervision and support from consultants, who are often more lenient with registrars starting their training. Registrars starting their training are often paired with more senior registrars, providing them with more support and teaching in the theatre environment. Final-year registrars are also given more attention and teaching as they are being prepared for their examinations. Secondly, the second and third years of training are stressful and demanding. These years include the specialist rotations such as cardiothoracic, neurosurgery and vascular; there is a steep learning curve and increase in responsibilities, and the bulk of the compulsory research component of the training programme takes place during these years.

The three highest scoring questions in this study were: "I feel responsible and accountable for the care given to my patients", "I discuss the anaesthetic plan of cases with the consultant" and "I am encouraged to visit patients preoperatively". All three questions form part of the autonomy domain. The level of responsibility and accountability given to trainees within the South African health system is evident by this question being one of the highest scoring. The preoperative visit and the discussion of the anaesthetic plan with the consultant are mandatory for anaesthesiology registrars at Wits. These also provide an excellent learning opportunity for the registrar and teaching opportunity for the consultant. The three lowest scoring questions in this study were: "There is an informative anaesthetic trainee handbook", "Whenever I should participate in formal educational programmes, I get relief from theatre duties" and "My workload in the hospital is manageable". Similarly, the study conducted by Cuthbert²⁵ concluded that some of the major shortcomings of the current learning environment according to registrars were the lack of relief from theatre duties for formal teaching, and the workload in the hospitals. There is no informative trainee handbook or equivalent document to guide the training programme of anaesthesiology registrars at Wits. Therefore, registrars resort to compiling their own document.

Discrimination in the workplace based on sex, gender and race are issues that have been receiving increasing attention. This study found that 20% of respondents agreed about the presence of sex- or gender-based discrimination and 21% agreed about the presence of racial discrimination. Of the respondents, 45% were neutral with regard to the presence of sex-, gender-

and race-based discrimination. Although most respondents in this study were neutral or disagreed with statements on sex-, gender- or race-based discrimination, these are still important social issues that need to be continuously addressed. In the qualitative study by Cuthbert,²⁵ very few narratives specific to sex-, gender- or race-based discrimination were voluntarily offered and, according to the author, this lack of commentary suggested that sex-, gender- and race-based discrimination were sensitive but less pertinent issues that required further investigation.

The possible limitations of this study are that this study was contextual to the Department of Anaesthesiology at Wits, and therefore the results of the study may not be generalisable to anaesthesiology departments at other institutions. Furthermore, the ATEEM instrument is unidimensional as it assesses only the registrars' perception of the educational environment and does not assess the perception of the educational environment by educators and other stakeholders.

Conclusion

The theatre educational environment is perceived as more positive than negative, but with room for improvement. All the domains, except that of autonomy, require attention to further improve the educational environment. With the availability of a validated instrument to assess the educational environment quantitatively, regular quality assessments of the educational environment should be included in the training institution's practice to ultimately produce competent specialists that provide the safest and highest quality of care to patients.

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Conflict of interest

The authors declare that they have no competing interests.

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Ethical approval

The study was approved by the Human Research Ethics Committee (Medical) and Graduate Studies Committee of the University of the Witwatersrand (protocol number M181049).

Completion of the questionnaire was voluntary and informed consent was implied on the return of the questionnaire.

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