

# Development of an instrument to measure the surgical operating theatre learning environment as perceived by basic surgical trainees

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**SUMMARY** *As a result of changes to surgical training in the United Kingdom, there has been a significant reduction in the number of hours worked by surgical trainees per week and in the total duration of surgical training. For trainees to achieve an acceptable level of surgical operative competence, the learning environment in the operating theatre needs to be optimized. In this context, an instrument to measure the learning environment in the operating theatre has been developed. Through a review of the literature and exploratory interviews with trainers and trainees, items that contribute to the learning environment in the operating theatre were identified. Based on these items a questionnaire was drawn up. For validation purposes, the questionnaire was circulated amongst basic surgical trainees on the Aberdeen rotation. This instrument was found to have high reliability and validity. Its potential usefulness for informing committees responsible for overseeing surgical training is discussed.*

## Introduction

Surgical training in the United Kingdom has changed dramatically, mainly as a result of the implementation of the Calman Report (Working Group on Specialist Medical Training, 1993). The total duration of surgical training has been reduced and in addition the working week for trainees has been significantly shortened as a result of the ‘New Deal’ (NHS Management Executive, 1991). The two changes together were estimated to reduce the time available for training a consultant by approximately 50% (Beecham, 1996). The actual hours of duty will fall even further to 48 hours per week, compared with more than 100 hours worked per week, with the implementation of the European Working Time Directive in 2004 (European Working Time Directive, 1993). The sum effect is an “erosion of training time and training opportunities” (Hurley & Paterson-Brown, 1999). Ogston *et al.* (2002) have shown that operative experience of surgical trainees has been significantly diminished. For trainees to achieve the same level of operative competence as their predecessors in a much shorter time, the learning environment in the operating theatre needs to be optimized.

As early as 1961, students’ perception of their learning environment was identified as an important determinant of the learning that takes place (Hutchins, 1961). In an analysis involving over 17,000 students from different countries Haertel and colleagues (1981) showed that positive environments and positive learning outcomes appear to go together. The UK Standing Committee on Postgraduate Medical Education (1991) has also emphasized the importance of a

working environment that is conducive to learning for successful training. This may be particularly so in the operating theatre.

However, in order to provide trainees with a ‘conducive learning environment’ it is important to have available a quality assessment tool. Such an instrument would not only provide a measure of the quality of the learning environment in theatre but also enable the identification of problem areas that require remedial action. It would serve not only to guide but also to prioritize. The same instrument could also be used to monitor the effect of any changes implemented to the learning environment in theatre.

Such an instrument could also be used for comparing the quality of the learning environment provided by different training units and centres. It could also contribute to the accreditation process and approval of training posts.

In order to address this need, we sought to develop an instrument to measure the learning environment in the operating theatre. The first step was to identify those elements that contributed to the learning environment, whether positively or negatively. A 40-item questionnaire was then developed based on the elements identified and validated amongst basic surgical trainees.

## Methods

### *Development of the questionnaire*

A literature review on instruments developed for measuring the learning environment in the field of medical education was carried out. Several relevant instruments were identified and the items and subscales making up these instruments were evaluated. These included the Medical School Learning Environment Survey (Marshall, 1978), an instrument to measure the learning environment as perceived by medical students (Pololi & Price, 2000), the Dundee Ready Education Environment Measure (Roff *et al.*, 1997), an instrument to measure the learning environment in hospital settings (Rotem *et al.*, 1995), the Clinical Learning Environment Inventory (Chan, 2001) and a questionnaire examining learning in general practice (Bligh & Slade, 1996). Two recently developed questionnaires (the Postgraduate Hospital Education Environment Measure and the Anaesthetic Theatre Education Environment Measure) were also reviewed. From these instruments, items and subscales that

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were relevant to the operating theatre learning environment were identified. This was based on whether items and subscales could be applied to the operating theatre learning environment.

Exploratory interviews were carried out with seven senior colleagues with extensive experience in surgical training. Exploratory interviews were also carried out with two basic and two higher surgical trainees. These were semi-structured interviews. Through these interviews elements that were considered to form the most important part of the learning environment in the operating theatre were identified.

The elements identified through exploratory interviews and the items identified through review of the literature were combined and after further review by the same surgical trainers and trainees a 40-item questionnaire was drawn up (Appendix 1). Four subscales were identified. Statements 1 to 13 covered trainees' perceptions of their trainer and training, statements 14 to 24 covered trainees' perceptions of learning opportunities, statements 25 to 32 trainees' perceptions of the atmosphere in the operating theatre and statements 33 to 40 trainees' perceptions on supervision, workload and support. Respondents were asked to tick one of five options: strongly agree, agree, uncertain, disagree, strongly disagree. The questionnaire also asked for information about the trainee's sex and level of training (Year 1, Year 2, Year 3, or > year 3).

*Validation of questionnaire*

A copy of the final questionnaire was sent to all 26 trainees on the Aberdeen Basic Surgical Training Programme by post. The questionnaires were anonymous and one reminder was sent out to all trainees.

For each statement, a score of 5 was given if the respondent 'strongly agreed', 4 if 'agreed', 3 if 'uncertain',

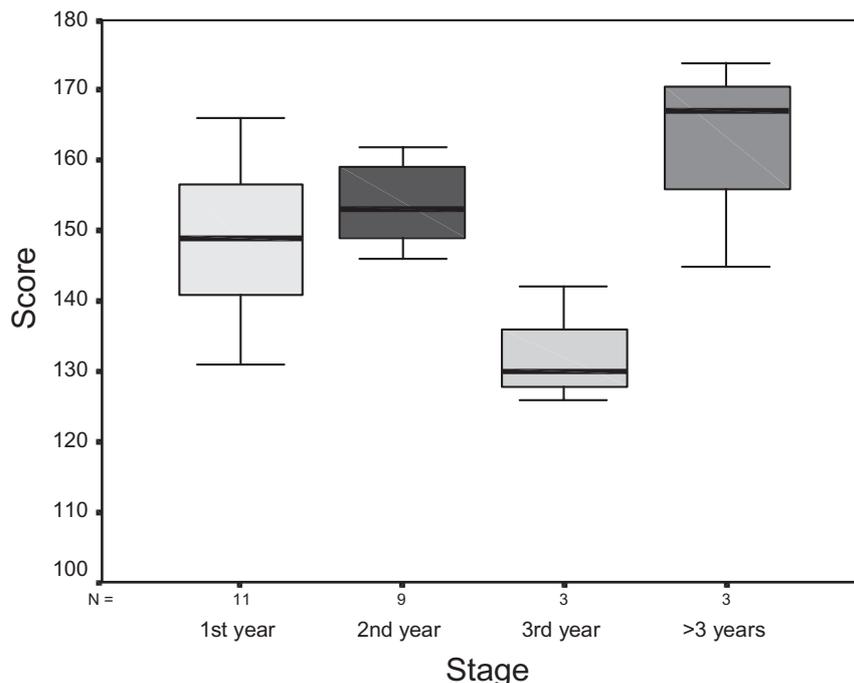
2 if 'disagreed' and 1 if 'strongly disagreed'. For negative statements (Statements 8, 11, 14, 16, 22, 23, 26, 27, 28, 30, 31, 33, 34, 35, 36, 37, 38, 40), the scoring was reversed. An overall total score was calculated for each respondent, and four subtotals for each of the four subscales were also calculated. Cronbach's reliability analysis was performed using Statistics Package for the Social Sciences (SPSS) Version 10 for the whole questionnaire and for each of the four sub-scales to measure internal consistency. Student's *t*-test was used to assess for differences between the sexes and one-way ANOVA to assess any differences based on the different levels of training.

**Results**

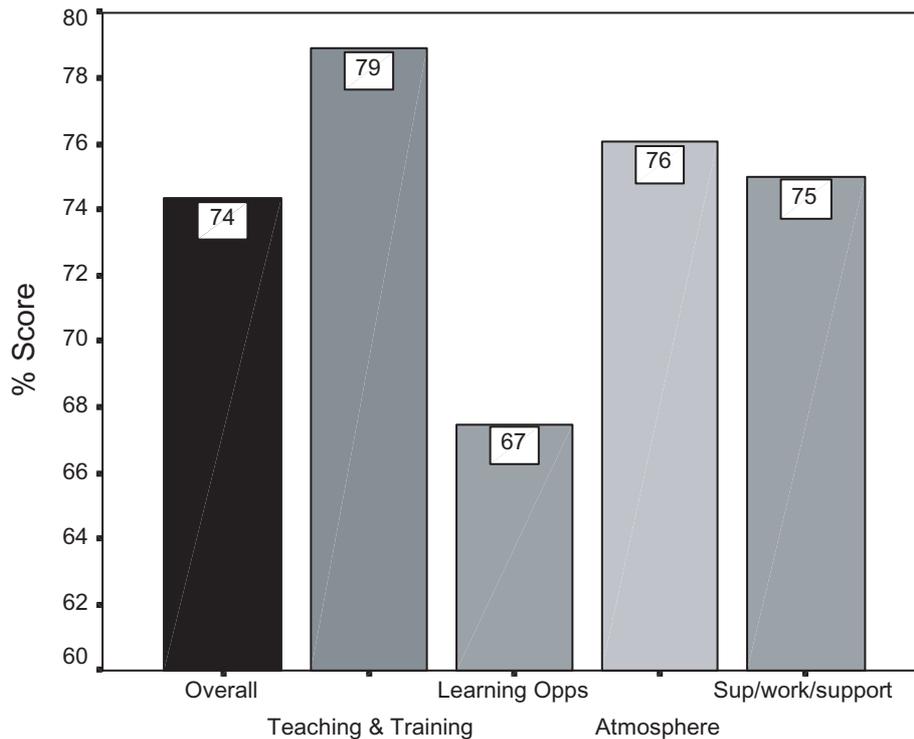
Questionnaires were sent out to all 26 basic surgical trainees, 20 males and six females, on the Aberdeen Basic Surgical Rotation. Only one male trainee failed to return the completed questionnaire, giving a response rate of 96.2%. Eleven trainees were in their first year, nine in their second, three in their third year and a further three trainees had been in basic surgical training posts for more than three years.

The questionnaire consisted of 40 statements each with a maximum score of 5, giving a maximum overall score of 200. The minimum score possible was 40. The mean overall score for the whole group was 148.7 (74.4%). There was no significant difference in overall score between male and female trainees. Similarly there was no significant effect of stage of trainees on overall scores although there was a downward trend between first- and third-year trainees (Figure 1).

Figure 2 shows the percentage scores for each of the four subscales and the overall percentage score. The 'Teaching and Training' subscale obtained the highest score of the four with a percentage score of 78.9%. The lowest score was for



**Figure 1.** Boxplots showing overall scores with stage of training.



**Figure 2.** Overall percentage score and percentage scores for individual subscales.

the 'Learning Opportunities' subscale at 67.5%. Again there were no significant differences between male and female scores for the four subscales. No significant difference was identified in the scores for each of the subscales between trainees at different levels of training. However, for the 'teaching and training' subscale the score tended to increase between the first and third year. In contrast there was a downward trend in scores between the first and third year for the 'learning opportunities' subscale.

The individual statements in the questionnaire that received the highest scores were: Statement 2: I get on well with my trainer (4.44/5); Statement 6: My trainer's surgical skills are very good (4.44/5); Statement 39: The level of supervision in theatre is adequate for my level (4.4/5).

On the other hand, the statements receiving the lowest scores were: Statement 20: The number of emergency procedures is sufficient for me to gain the right operative experience (2.8/5); Statement 27: The nursing staff dislike it when I operate as the operation takes longer (2.48/5); and Statement 38: I get bleeped during operations (2.28/5).

Cronbach's alpha coefficient was measured, as an indication of the internal consistency of the questionnaire, as a whole and for each of the four subscales. For the whole questionnaire Cronbach's alpha was 0.877. For the 'teaching and training' subscale Cronbach's alpha was 0.842, for 'learning opportunities' 0.589, for 'atmosphere' 0.574, and for the 'supervision/workload/support' subscale 0.569. Spearman's correlation coefficient was calculated for each statement score with regard to the overall score and with regard to the subscale score. All statement scores except statements 13, 23, 26, 30 and 40 showed acceptable correlation with the overall score and subscale score, with a range of 0.29 to 0.81. There was a significant correlation

between 'learning opportunities' and 'atmosphere' subscale scores (Spearman's  $\rho = 0.67$ ) but no significant correlation between the other subscales.

## Discussion

Interest in the learning environment in medical teaching institutions developed as a result of a change in the conceptualization of the dynamics of student experiences and their impact on learning (Marshall, 1978). As early as 1961 it was recognized that the learning environment was an important determinant of the learning that takes place in that environment (Hutchins, 1961). An analysis of over 17,000 students from different countries showed that "positive environments and positive learning outcomes appear to go together" (Haertel *et al.*, 1981). It is for this reason that the UK Standing Committee on Postgraduate Medical Education (SCOPME, 1991) has emphasized the importance of environments that are conducive to learning for successful training.

In order to develop an environment that is conducive to learning there are two prerequisites. First of all, the major elements that contribute to the particular learning environment need to be identified. Second, an instrument to measure that learning environment needs to be available to allow accurate assessment of the learning environment and to identify those areas that require attention. The same instrument could subsequently be used to monitor the effect that any changes implemented have made. In the case of the learning environment in the surgical operating theatre both of these prerequisites were absent. It was for this reason that we sought to develop an instrument to measure the learning environment of the surgical operating theatre.

Identifying what constitutes and what contributes to a particular learning environment, however, is not easy. The learning environment has been defined as “everything that is happening” (Genn, 2001) and includes “the climate, or atmosphere, or ethos, tone or ambience, and the culture or personality of the institution” (Pace & Stern, 1958). These are at best “intangible aspects” (Roff & McAleer, 2001). In order to develop an instrument to measure the learning environment, concrete aspects of that environment need to be identified. Through a literature review and exploratory interviews with both surgical trainees and trainers we identified those elements that contribute to the learning environment in the surgical operating theatre. The questionnaire developed was based on these elements.

Validation of the questionnaire was performed by circulating it amongst basic surgical trainees. Although the sample of trainees was small, this was sufficient for the purposes of validation. The internal consistency reliability coefficient of 0.877 (Cronbach’s alpha) is sufficiently high. This compares well with other instruments developed for measuring learning environments in the medical setting. The Medical School Learning Environment Survey had a coefficient of 0.89 (Feletti & Clarke, 1981), the Dundee Ready Education Environment Measure a coefficient of 0.91 (Roff *et al.*, 1997) and a questionnaire developed by Bligh & Slade (1996) had a coefficient of 0.76. Cronbach’s alpha coefficient is one of the most commonly used reliability coefficients and a level of 0.6 is considered acceptable in questionnaires (Nunnally, 1978).

Cronbach’s alpha coefficient for the individual subscales ranged from 0.569 to 0.842. These results compare well with those for other instruments developed for measuring learning environments. The subscales on the questionnaire of Bligh & Slade (1996) had Cronbach’s alpha coefficients of between 0.21 and 0.74. Subscales on other similar instruments had Cronbach’s alpha coefficients of between 0.49 and 0.92 (Rothman & Ayoade, 1970; Feletti & Clarke, 1981; Biddle *et al.*, 1985; Rotem *et al.*, 1995; Pololi & Price, 2000; Primparyon *et al.*, 2000). The high coefficients obtained for the whole questionnaire and for the four subscales indicate overall internal consistency of the instrument. The low correlation between the different subscales (with the exception of ‘atmosphere’ with ‘learning opportunities’) implies that each subscale is measuring a distinct aspect of the operating theatre learning environment.

The feedback from both trainees and trainers, as well as the correlation between statement scores and overall scores and subscale scores, suggests that the content validity of the questionnaire is satisfactory.

The availability of this instrument to measure the learning environment in the surgical operating theatre should serve as an important quality assessment tool. In the case of the Aberdeen trainees, the overall score given suggests that their learning environment is satisfactory. The ‘learning opportunities’ subscale was given the lowest score by the trainees, although this was still satisfactory. By analysing the separate subscale scores, the instrument can serve to establish which areas of the learning environment could be improved, and also to prioritize changes. By re-administering the questionnaire after changes have been implemented, the effect of these changes can be assessed. The instrument could also serve as a comparative tool and possibly contribute towards

the process through which surgical training posts are approved.

### Notes on contributor

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**Appendix 1: Final questionnaire**

*Theatre Learning Environment for Basic Surgical Trainees*

Male  Female

What stage of training are you at?

SHO Year 1

SHO Year 2

SHO Year 3

Other: \_\_\_\_\_

Please indicate whether you strongly agree (SA), agree (A), are unsure (U), disagree (D) or strongly disagree (SD) with each of the statements below by circling the appropriate response. Your answers should reflect the situation in the operating theatre at your current post. ‘My trainer’ in the statements below refers to the consultant with whom you have spent most time in theatre.

1	My trainer has a pleasant personality	SA	A	U	D	SD
2	I get on well with my trainer	SA	A	U	D	SD
3	My trainer is enthusiastic about teaching	SA	A	U	D	SD
4	My trainer has a genuine interest in my progress	SA	A	U	D	SD
5	I understand what my trainer is trying to teach me	SA	A	U	D	SD
6	My trainer’s surgical skills are very good	SA	A	U	D	SD
7	My trainer gives me time to practise surgical skills in theatre	SA	A	U	D	SD
8	My trainer immediately takes the instruments away when I do not perform well	SA	A	U	D	SD
9	Before the operation my trainer discusses the surgical technique planned	SA	A	U	D	SD
10	Before the operation my trainer discusses what part of the procedure I will perform	SA	A	U	D	SD
11	My trainer expects my surgical skills to be as good as his/hers	SA	A	U	D	SD
12	My trainer gives me feedback on my performance	SA	A	U	D	SD
13	My trainer’s criticism is constructive	SA	A	U	D	SD
14	On this unit the type of operations performed are too complex for my level	SA	A	U	D	SD
15	The elective operating list has the right case mix to suit my training	SA	A	U	D	SD
16	There are far too many cases on the elective list to give me the opportunity to operate	SA	A	U	D	SD
17	I get enough opportunity to assist	SA	A	U	D	SD
18	There are enough theatre sessions per week for me to gain the appropriate experience	SA	A	U	D	SD
19	More senior trainees take my opportunities to operate	SA	A	U	D	SD
20	The number of emergency procedures is sufficient for me to gain the right operative experience	SA	A	U	D	SD
21	The variety of emergency cases gives me the appropriate exposure	SA	A	U	D	SD
22	My trainer is in too much of a rush during emergency cases to let me operate	SA	A	U	D	SD
23	I miss out on operative experience because of restrictions on working hours	SA	A	U	D	SD
24	I have the opportunity to develop the skills required at my stage	SA	A	U	D	SD
25	The atmosphere in theatre is pleasant	SA	A	U	D	SD
26	In theatre I don’t like being corrected in front of medical students, nurses and residents	SA	A	U	D	SD
27	The nursing staff dislike it when I operate as the operation takes longer	SA	A	U	D	SD
28	The anaesthetists put pressure on my trainer to operate himself to reduce anaesthetic time	SA	A	U	D	SD
29	The theatre staff are friendly	SA	A	U	D	SD
30	I feel discriminated against in theatre because of my sex	SA	A	U	D	SD
31	I feel discriminated against in theatre because of my race	SA	A	U	D	SD
32	I feel part of a team in theatre	SA	A	U	D	SD
33	I am too busy doing other work to go to theatre	SA	A	U	D	SD
34	I am often too tired to get the most out of theatre teaching	SA	A	U	D	SD
35	I am so stressed in theatre that I do not learn as much as I could	SA	A	U	D	SD
36	I am asked to perform operations alone that I do not feel competent at	SA	A	U	D	SD
37	When I am in theatre, there is nobody to cover the ward	SA	A	U	D	SD
38	I get bleeped during operations	SA	A	U	D	SD
39	The level of supervision in theatre is adequate for my level	SA	A	U	D	SD
40	Theatre sessions are too long	SA	A	U	D	SD

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