Original Article

Assessment of Psychometric Properties of a Modified PHEEM Questionnaire

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Abstract

Background: An effective tool in analysing the learning environment, customised to the Sri Lankan setting, is vital for the assessment and delivery of quality healthcare training of pre-registration house officers. Such a tool should be reliable and valid. We assessed psychometric properties such as internal reliability and construct validity of a modified version of the Postgraduate Hospital Educational Environment Measure (PHEEM). Materials and Methods: A modified PHEEM questionnaire customised to the Sri Lankan context was developed in accordance to the Sri Lanka Medical Council guidelines. The questionnaire was distributed to all interns at the National Hospital of Sri Lanka, Colombo North Teaching Hospital and Wathupitiwala Base Hospital during a calendar year (n = 100, response rate = 86%). Internal reliability and construct validity of the inventory were assessed by using Cronbach's alpha and exploratory factor analysis respectively as statistical methods. Results: PHEEM consists of 3 subscales: perceptions of autonomy, social support and teaching, which are factors perceived to be influencing the educational environment. This administration demonstrated high internal reliability as reflected by a Cronbach's alpha value of 0.84. Exploratory factor analysis identified 12 factors with eigenvalue >1. However, the first factor had an eigenvalue of 6.7 (accounting for 19.7% of variance), while the rest had eigenvalues < 2.5. These results suggest a single predictive factor and thus a one-dimensional scale as opposed to the three-dimensional scale which is used in the current questionnaire. Conclusions: The psychometric properties of this tool reflect a high degree of internal reliability in assessing the educational environment of intern doctors in Sri Lanka. It is possible that the clinical educational environment is collectively represented as a single dimension. This may be due to the complex interplay between individual items in the questionnaire. Therefore the psychometric properties do not justify the interpretation of the educational environment through specified subscales.

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Key words: Clinical training, Learning environment, Psychometric analysis

Introduction

In Sri Lanka, after a 5-year medical undergraduate curriculum, graduates from the medical faculties undergo a one year mandatory internship or housemanship, 6 months each in 2 selected disciplines of clinical medicine, surgery, paediatrics, obstetrics & gynaecology and paediatric surgery in a recognised government hospital. After successful completion of this period of training, they are registered by the Sri Lanka Medical Council to practice as a medical professional. The hospital must be a learning organisation with qualities of information sharing, worker participation and innovation; and establishment of such a supportive learning-oriented culture is of utmost significance in training competent physicians.[1,2] Therefore the educational environment of this hospital-based training period plays a vital role in the quality of their training.

The educational environment is an important determinant of student behaviour and is related to their achievements, satisfaction and success. Thus, understanding these educational environments and sub-environments is fundamental to managing curriculum development and change.[3,4] The medical undergraduate learning environment in Sri Lanka has been measured using the Dundee Ready Education Environment Measure (DREEM) and has shown to be positive.[5] However in their perceptions of the final year, the learning environment was found to be in need of improvement.[6]

In this context, it is important to measure the educational

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environment during the final stage of basic medical training, the internship. Indeed, the UK Postgraduate Medical Education and Training Board has included trainee perceptions of their training experience as a part of the quality assurance for accreditation.[7]

A 40-item inventory to measure the various aspects of junior doctor training in the UK and Ireland, named the Postgraduate Hospital Educational Environment Measure (PHEEM) was developed by Roff et al. Qualitative research methodologies i.e. grounded theory development through focus groups, nominal groups and a Delphi panel drawn from the target population, was used to validate the items of the PHEEM.[8] PHEEM has been translated into Danish and subsequently validated with good internal consistency by junior and senior doctors in Denmark.[9]

The objective of the present study was to modify and validate PHEEM to suit the Sri Lankan context. In order to validate this inventory, 2 psychometric properties of the modified PHEEM were investigated. The first psychometric property was the construct validity, which refers to whether a scale measures or correlates with a theorised psychological construct. In this study, the construct is the existence of 3 factors in the clinical learning environment, namely the 3 subscales of PHEEM. The second property tested was the reliability of the questionnaire, defined as reproducibility of data or scores, independent of time and occasion.[10]

Materials and Methods

A modified PHEEM questionnaire (Fig. 1) consisting of 34 items belonging to the 3 defined subscales (perceptions of role autonomy, perceptions of teaching and perceptions of social support) of the original questionnaire, customised to the Sri Lankan context, was developed in accordance with the Sri Lanka Medical Council guidelines. Six items of the original questionnaire were deleted as they were deemed irrelevant to the Sri Lankan setting. The questionnaire was administered to all intern house officers resident at the National Hospital of Sri Lanka, Colombo North Teaching Hospital and Wathupitiwala Base Hospital from 1 May 2007 to 1 May 2008 (n = 100). They were asked to rate each item on a 5-grade Likert-type scale (from strongly agree = 4 to strongly disagree = 0, as in the original PHEEM). The 3 items containing negative statements (items 7, 10 and 19) had their score inverted on the scale. Eighty-six doctors responded. Data were analysed using the SPSS statistical programme.

Internal reliability and construct validity was assessed using Cronbach's alpha co-efficient and exploratory factor analysis respectively.

Cronbach's alpha co-efficient is an estimator of internal reliability that increases as the correlations between items increase.[11]

Construct validity is evaluated statistically by demonstrating whether or not a common construct can be shown to underlie several measurements of different observable indicators. Factor analysis is one such statistical method which explains the variability among observed variables (i.e. items of the inventory) in terms of fewer unobserved variables called factors[12] (i.e. presumed subscales of the inventory). Factor analysis can assess the validity of an instrument by ascertaining if the instrument in question indeed measures the postulated factors. It has been used in a broad range of domains such as measurement of personality, attitudes and beliefs and is therefore a suitable method to validate an inventory measuring the learning environment**.**

For the results of factor analysis to be valid, the extraction values of observed variables should be greater than 0.5. All items of the modified PHEEM questionnaire satisfied this criteria. Therefore, exploratory factor analysis was used as a valid statistical method although the number of respondents was 86.

Eigenvalues correspond to the variance as explained by the factors; and according to the Kaiser-Guttman criterion factors with eigenvalues greater than 1.00 are considered significant, explaining an important amount of the variability in the data. Similarly, eigenvalues less than 1.00 are considered insignificant, as they do not explain data variability. Therefore in this study, only factors with eigenvalue >1.00 were considered.

Results

The administration of the questionnaire revealed a Cronbach's alpha value of 0.84. This reflects high internal reliability as any value of over 0.6 is accepted as reliable.[13]

Confirmatory factor analysis revealed 12 factors with eigenvalue >1, explaining a cumulative percentage of variance of 72.7%. However, the first factor had an eigenvalue of 6.7 (accounting for 19.7% of variance), and the other 11 factors had eigenvalues <2.5. These findings are not consistent with a questionnaire measuring 3 distinct factors. In such a case, the results should show 3 factors with relatively high eigenvalues each accounting for a sizeable percentage of the variance. The following scree plot graphically illustrates the eigenvalues of these factors in their decreasing order (Fig. 2). According to the scree test (when the analysis is limited up to the end of the rapid descent of the plot) only a single factor was revealed. Therefore, both these methods of analysis suggest a single predictive factor i.e. a one-dimensional scale.

		Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	My consultant sets clear standards to be achieved	□	□	□	□	□
2	I'm able to allocate time for continuous medical education	□	□	□	□	□
3	I had an informative orientation programme	□	□	□	□	□
4	I have the appropriate level of responsibility in this position	□	□	□	□	□
5	I have good clinical supervision	□	□	□	□	□
6	My working hours confirm to the guidelines provided by the SLMC	□	□	□	□	□
7	I have to perform inappropriate tasks	□	□	□	□	□
8	There is an informative guideline book for internship	□	□	□	□	□
9	My consultant/seniors have good communication skills	□	□	□	□	□
10	There is sex discrimination in this post	□	□	□	□	□
11	There are clear clinical protocols in this post	□	□	□	□	□
12	My consultant/seniors are enthusiastic	□	□	□	□	□
13	I have good collaboration with my co-house officers	□	□	□	□	□
14	I have suitable access to career guidance	□	□	□	□	□
15	This hospital has good quality accommodation for house officers, specially when on call	□	□	□	□	□
16	I get regular feedback from seniors	□	□	□	□	□
17	My consultant is well organized	□	□	□	□	□
18	I feel physically safe within the hospital environment/ward	□	□	□	□	□
19	I'm blamed inappropriately by my consultant/seniors	□	□	□	□	□
20	There are adequate catering/canteen facilities in the hospital	□	□	□	□	□
21	I have enough clinical learning opportunities	□	□	□	□	□
22	My consultant has good teaching skills	□	□	□	□	□
23	I feel part of the team working here	□	□	□	□	□
24	I have opportunities to perform appropriate practical procedures	□	□	□	□	□
25	My seniors and consultants are accessible	□	□	□	□	□
26	My workload in this post is fine	□	□	□	□	□
27	My consultant is a good role model	□	□	□	□	□
28	I get a lot of enjoyment out of my present job	□	□	□	□	□
29	My consultant/seniors encourage me to be an independent learner	□	□	□	□	□
30	The consultant/seniors provide me with good feedback on my strengths and weaknesses	□	□	□	□	□
31	My consultant/seniors promote mutual respect among members of my unit	□	□	□	□	□
32	My consultant is up-to-date in knowledge	□	□	□	□	□
33	Internship gave me opportunity for research	□	□	□	□	□
34	The training in this post makes me feel ready to practice independently as a medical officer	□	□	□	□	□

Note: Items that were removed from the original PHEEM due to not being relevant to the Sri Lankan setting

1. There is racism in this post
2. I am bleeped inappropriately
3. I am able to participate actively in educational events
4. My hours conform to the new deal
5. I have opportunity to provide continuity of care
6. There are good counseling opportunities for junior doctors who fail to complete their training satisfactorily

Fig. 1. Modified PHEEM questionnaire.

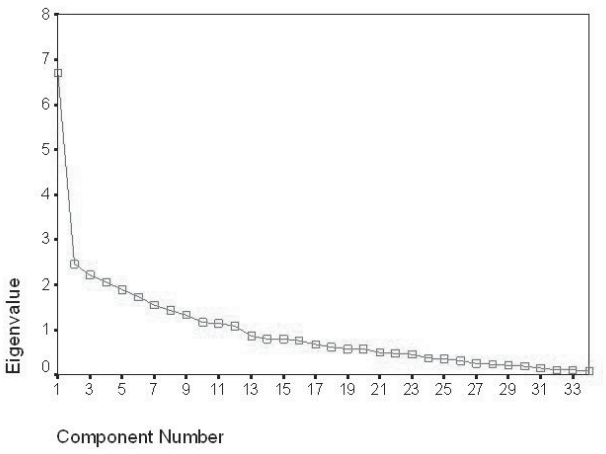

Fig. 2. Scree plot depicting a one-dimensional scale.

Discussion

The Standing Committee on Postgraduate Medical Education (SCOPME) states that a working environment that is conducive to learning is critically important to successful training.[14] Learning depends on engaging the learner, which is determined by motivation and perception of relevance. These, in turn, can be affected by learners' previous experiences and preferred learning styles and by the context and environment in which the learning is taking place. Therefore the educational environment plays a crucial role in the learning process.[15]

The educational environment is highly complex and defining it is a very complicated task. Genn[3] explains it as "a set of factors that gives each situation a personality, a spirit, a culture; a big buzzing confusion, a complex, chaotic kind of situation, with countless components, myriad dynamics and interactions of inputs and processes, inevitable conflicts, and constantly in a state of flux".

The clinical learning environment too has such countless components as reflected by "differences in the orientation towards teaching and learning, the level of autonomy, variety and workload, the quality of supervision and social support, type and quality of opportunities for practice of important skills and the availability of educational resources".[16]

In an attempt to analyse the clinical learning environment qualitatively, 5 components that constitute learning experiences in clinical internship were revealed. Namely, the agenda of the internship, the attitude of the supervisor, the culture of the training setting, the intern's learning attitude and the nature of the learning process.[17]

Attempts have been made to identify and measure these components through inventories, which group the identified components as subscales. An analysis of previous studies shows a variability in the nature and number of these perceived subscales.

In DREEM, qualitative methods (grounded theory employing the Delphi technique) were used to generate 5 subscales, i.e. students' perceptions of teaching, teachers, academic self perceptions, atmosphere and social self perceptions.[18] However, other inventories measuring learning environment of medical schools identify different subscales to make up this environment. The Learning Environment Questionnaire (LEQ) has scales for goal direction, academic enthusiasm, internal and external pressures on students, student interaction and authoritarianism, while in the Medical School Learning Environment Survey; meaningful learning experience, nurturance of the environment, flexibility within the educational experience, emotional climate for students, and student-to-student interaction are the typical subscales.[19]

Subscales have also been identified in developing and validating inventories to measure the clinical learning environment. Such identified subscales range from role autonomy, teaching and social support for hospital-based junior doctors (PHEEM),[20] to teaching and training, learning opportunities, atmosphere and supervision/ workload/ support in surgical operating theatres (STEEM);[21] to autonomy, atmosphere, supervision/workload/support, teachers and teaching and learning opportunities and orientation to learning for anaesthetists (ATEEM).[22]

Psychometrics of PHEEM have been evaluated in different settings. In 2 studies done in the UK, it scored a high reliability, reflected by Cronbach's alpha values of 0.91 and 0.92.[20] Validation of PHEEM in a Danish hospital setting returned a Cronbach's alpha value of 0.93.[9] PHEEM has been demonstrated to give reliable outcomes in the Netherlands for single departments as well as groups of departments, through feasible sample sizes.[23]

The construct validity of PHEEM has been assessed in the study by Boor et al[23] in the Netherlands by using exploratory factor analysis and the Kaiser-Guttman criterion. The analysis suggested a one dimensional scale instead of the hypothesised 3 subscales. These findings are similar to the results of this study.

In a study exploring the construct validity of the 5 subscales of DREEM among residents in Brazil, principle component factor analysis showed a single factor with an eigenvalue of 14.5 explaining 29% of the total variance. The rest of the factors had eigenvalues <4 with relatively small percentages of variance explained; thus revealing a one dimensional scale.[24]

In summary, the reviewed literature suggests that the components which influence the learning environment are many and interrelated. Our study identifies a one-dimensional scale for a modified PHEEM with 3 subscales. Although there is a possibility of altering the construct

during the modification, several other studies also strengthen our argument by identifying a one dimensional scale for inventories with several subscales.

This result may be explained by the complex interrelation of the observed variables (i.e. items of the inventory) that may add or negate the effect of others. Therefore, these items may not be able to influence the environment individually but may do so collectively. It is possible that these are collectively represented as a single dimension in our study.

This leaves us with a question: though highly reliable and valid as tools of measurement of the learning environment as a whole, how valid are we in interpreting and comparing the different subscales of these inventories? Further research should be conducted both conceptually and psychometrically to find the answer.

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