

# Development and Validation of Scale Assessing the Preparedness of Objective Structured Clinical Examination in Undergraduate Competency based Medical Education

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## Abstract

**Background:** Formative assessments methods such as objective structured clinical examination (OSCE) are reliable and valid assessment tools employed under the competency-based medical education (CBME) curriculum. However, there was no uniform scale to assess the attributes of OSCE for any of the medical subjects. Hence, this study was done to develop and validate a scale to assess the attributes of OSCE and make sure that the intended objectives of the OSCE are achieved. **Methods:** The scale was developed using literature review and expert opinion. It consisted of 10 questions and response to these items was based on a 5-point Likert scale ranging from “strongly agree” to “strongly disagree.” The final version was administered among 30 students undertaking survey community diagnosis (CD) posting during their third semester. Exploratory and confirmatory factor analysis was performed to validate the scale. **Results:** Two-factor structures were obtained with eigenvalues of 4.32 and 1.90. Factor 1 consisted of seven items (positively faced questions) accounting for 42.84% of the variance, whereas Factor 2 had the remaining three items (negatively faced questions) explaining 19.36% of the variance. Thus, together, the two factors explained 62.20% of the variance. Goodness-of-fit indices revealed good Comparative fit index (CFI) s of 0.90, Tucker Lewis index (TLI) of 0.87, and acceptable Standardized Root Mean Square Residual (SRMR) of 0.13. The reliability coefficient (Cronbach’s alpha) for the scale was 0.81. **Conclusion:** This study develops and validates a scale that can be used universally for assessing the attributes of OSCE across all disciplines and in medical education institutes in India.

**Keywords:** Medical education, objective structured clinical examination, validation studies

## INTRODUCTION

Competency-based medical education (CBME) has gained significant momentum over the years across the globe.<sup>[1]</sup> Widespread adoption of CBME would ensure a paradigm shift in the curriculum of medical education. CBME has also been adopted recently as a novel curriculum for Indian medical undergraduates.<sup>[2]</sup> CBME differs immensely from the traditional curriculum, especially in the assessment. Formative assessments methods such as “objective structured practical examination (OSPE),” “objective structured clinical examination (OSCE),” and “mini clinical evaluation exercises” are reliable and valid assessment tools employed under the CBME curriculum.<sup>[3]</sup> OSCE is a process of clinical examination where the present choices are made on the competencies to be examined and specifications incorporating important evaluable skills are prepared.<sup>[4]</sup> The organization of an OSCE

requires a lot of thinking, time, cooperation among examiners, and advance planning as compared to conventional clinical examination.<sup>[5]</sup> It is more objective because each clinical competency is broken down into smaller components. OSCE is very useful in providing feedback to students that help in correcting their deficits easily.<sup>[6,7]</sup>

Given the wider applicability of OSCE across the medical education institutes in India, it is important to have a uniform

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way of conducting and organizing the assessment for each of the medical subjects. OSCE applied in each of the medical institutes should cover the basic attributes so that the purpose of OSCE is achieved and appropriate feedback is obtained. However, to our knowledge, there is no uniform scale to assess the attributes of OSCE for any of the medical subjects. The preventive and social medicine department in our institute has performed OSCE as a part of the formative assessment for undergraduate medical students. We have developed a scale to assess the attributes of the conducted OSCE sessions to make sure that the intended objectives of the OSCE are achieved. We have also validated this scale using explanatory and confirmatory factor analysis to ensure that the scale can be used universally for assessing the attributes of OSCE across all disciplines and in medical education institutes in India.

## METHODS

**Study setting and participants:** This validation study was conducted among the third-semester undergraduate students of a centrally run medical institute located in Pondicherry. During their third, fifth, and seventh semesters, students must undergo community diagnosis (CD) posting under the department of preventive and social medicine (PSM) with the objectives of this posting to make the students understand the basic survey methodology by collecting basic sociodemographic information, conducting environment assessment, assessing the respondent's knowledge of specific diseases, collecting details about the acute and chronic illness, studying the treatment-seeking behavior, contraceptive practices, immunization and feeding practices; understanding the health-related community development programs, and finally delivering proper health education to different sections of the community. For this study, we recruited students undertaking survey CD posting during their third semester (mid-September to mid-October 2019). In total, 120 students were present in the third semester and split into four batches (30 in each batch). The usual mode of evaluation at the end of posting was a written examination or viva-voce. However, for this posting, OSCE was conducted to evaluate the knowledge and skill acquired by students.

**Phases of OSCE:** In total, three phases were involved in the conduct of OSCE examination:

**Phase 1—Preparation for OSCE:** In this phase, members of the examiner team listed the competencies to be tested and prepared the checklist for evaluation. After preparing 10 sets of OSCE stations, it was discussed with the other faculty in the department for their expert opinion. After incorporating the suggested modifications and reaching a consensus with experts, eight stations were finalized. The materials and marking patterns for each station were also finalized during this phase.

**Phase 2—Conducting OSCE:** During this phase, students were first orientated on OSCE and instructions regarding the time allotment for each station and direction of movement. In the five procedural stations, examiners were available for

the assessment of competency, and feedback was provided immediately. OSCE was conducted for small batches of seven to eight students over 2 days.

**Phase 3—Debriefing and feedback phase:** Feedback was collected from the students following the completion of all OSCE stations. A Google form consisting of pre-tested semi-structured questions was used for gathering the feedback. The questionnaire contained three sections for evaluating the perception, acceptability, and feedback of students about OSCE.

**Development of feedback scale for assessing the attributes of OSCE from students' perception:** We developed a scale to assess the attributes of the OSCE. The items in this scale were developed from the literature review and expert opinion. In total, 10 questions were designed as a draft questionnaire. Then, the face and content validity of the scale was ensured by reviewing the items for their appropriateness, relevance, ambiguity, syntax, and difficulty. A team of experts under the department of PSM was involved to ensure the content validity of the scale. All 10 questions were retained at the end of the validity process. However, a slight modification was done in the structure of some questions to make them easy, appropriate, and relevant. The response to these items was based on a 5-point Likert scale ranging from "strongly agree" to "strongly disagree."

**Statistical analysis:** Data were extracted from the Google form spreadsheet and analysis was performed using STATA version 14.2 (StataCorp, College Station, TX, USA). Continuous variables such as age were summarized as mean and standard deviation (SD). Attributes of OSCE were summarized as proportions. Before starting the validation process, two basic assumptions on inter-correlation of items and adequacy of sample size were checked using Bartlett's test of sphericity and Kaiser Meyer Olkin (KMO) measures of sampling adequacy. Both these assumptions were satisfied as the *P* value was less than 0.05 in Bartlett's test and KMO had a value more than 0.5. Hence, we performed the exploratory factor analysis (EFA) using principal component extraction with varimax rotation. Factors with eigenvalue (amount of variance explained by each factor) more than one were retained and interpreted as factor models. Factor loadings with values >0.4 were taken for the characterization of its factor model.<sup>[8,9]</sup> Further confirmatory factor analysis (CFA) was performed using structural equation modeling (SEM). It was done to test the results acquired from EFA and determine the goodness-of-fit of the obtained factor models. The following fit indices were used for assessing the goodness-of-fit: comparative fit indices (CFIs), Tucker-Lewis Index (TLI), and standardized root mean square residual (SRMR). The acceptable cut-off for these indices was CFI ≥ 0.90, SRMR ≤ 0.10, and TFI ≥ 0.90.<sup>[10]</sup> Internal consistency of the scale was assessed using Cronbach's alpha coefficient.

## RESULTS

The mean (SD) age of the study participants was 18.7 (0.6) years. Students' perception toward attributes of OSCE is

summarized in Table 1. The majority of the students agreed that the OSCE covered a wide range of learning objectives (80%), highlighted their weaknesses (76.6%), provided opportunity for them to learn through feedback (70%), allowed them to compensate in some areas (66.7%). The examination was well-structured (66.7%), well-administered (66.6%), and fair (63.3%). Fewer students complained that they needed more time at stations (20%) and examination was stressful (10%), intimidating, and scary (3.3%).

**Factorial structure:** Bartlett's test of sphericity was statistically significant (Chi-square 129.65,  $P < 0.001$ ) indicating good intercorrelation between items in the scale. The KMO value was 0.713, indicating that 71% of the variance is likely to be explained by the factors. This ensures sampling adequacy in performing the EFA. Table 2 displays the pattern from EFA conducted using the PCA method. Two factors were retained as they had eigenvalue more than 1 (4.32 and 1.90), and the factor loadings were generated using varimax rotation. Factor 1 consisted of seven items (Item 1, Item 2, Item 4, Item 6, Item 7, Item 8, and Item 10—positively faced questions) accounting for 42.84% of the variance, whereas Factor 2 had the remaining three items (Item 3, Item 5, and Item 9—negatively faced questions) explaining 19.36% of the variance. Thus, together, the two factors explained 62.20% of the variance.

The model obtained through EFA was further analyzed by CFA. The two-factor models were generated using the structural equation modeling as shown in Figure 1. Goodness-of-fit indices revealed good CFIs of 0.90, TLI of 0.87, and acceptable SRMR of 0.13. Thus, the two-factor model revealed in the EFA showed an adequate model fit in confirmatory analysis.

**Reliability (internal consistency):** Cronbach's alpha (reliability coefficient) for the scale assessing the attributes of OSCE was 0.81, indicating good internal consistency.

## DISCUSSION

OSCE has gained relevance as a formative and summative assessment tool throughout the country, especially after the introduction of CBME for the medical curriculum in India. Assessing the preparedness of OSCE assessment can help the

faculties in medical education to ensure the appropriateness, relevance, and usefulness of the assessment system.

We developed a scale assessing the preparedness of the OSCE examination applied during a community diagnosis posting in the PSM department. Then, content validation was performed with subject experts to identify whether the questions in the scale were relevant to assess the attributes of the OSCE. Following the process of content validity, the scale had 10 questions graded using a Likert scale. The scale developed in our study was validated as per the recommendations from the literature.<sup>[11]</sup>

Construct validity was assessed through exploratory factor analysis and it was intended to evaluate the theoretical construct of our scale. It is a useful and important method to develop, refine, and evaluate the scale.<sup>[12]</sup> This method has been widely applied in developing a scale or measuring an instrument across various fields such as social sciences and psychology.<sup>[13]</sup> We have applied the same method for validating the scale in medical education.

The factor analysis revealed a two-factor structure for positive- and negative-ended questions, and it was further confirmed using confirmatory factor analysis with acceptable fit indices. The reliability assessment (Cronbach's alpha) showed that the items in the scale had good internal consistency. Application of this scale across different medical education settings with a more representative sample, longitudinal cohort, multi-group CFA, and additional test-retest studies can help in providing additional information. Future studies addressing issues such as identifying the sources of domain-specific insufficient saturation and subscale factor reliability enhancement can be done. Although various studies have assessed the student's perception, attitude, and feedback about the OSCE conducted across the pre-clinical, para-clinical, and clinical departments, an attempt to validate the scale was lacking in most of these studies.<sup>[14-16]</sup> Hence, we could not compare our validation findings with any of these previous studies.

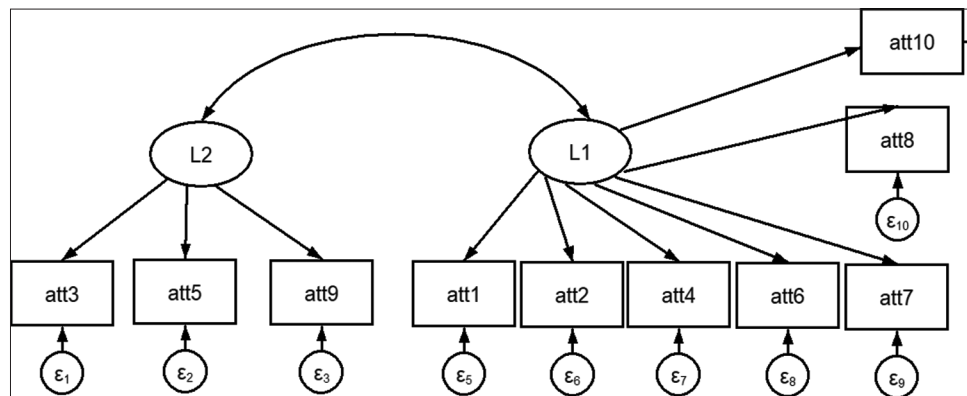
To the best of our knowledge, this study is the first one to develop and validate a scale to assess the attributes of OSCE in medical education. In addition, we have found the scale to have

**Table 1: Student's perception regarding the attributes of OSCE (n=30)**

Characteristics	Strongly disagree (%)	Disagree (%)	Neutral	Agree (%)	Strongly agree (%)
Examination was fair	0 (0)	4 (13.3)	7 (23.3)	10 (33.3)	9 (30.0)
Wide range of learning objectives were covered	0 (0)	0 (0)	6 (20.0)	13 (43.3)	11 (36.7)
Needed more time at stations	1 (3.3)	12 (40.0)	11 (36.7)	4 (13.3)	2 (6.7)
Examination was well administered	0 (0)	1 (3.3)	9 (30.0)	13 (43.3)	7 (23.3)
Examination was very stressful	4 (13.3)	14 (46.7)	9 (30.0)	3 (10.0)	0 (0)
Examination was well structured	0 (0)	0 (0)	10 (33.3)	15 (50.0)	5 (16.7)
Examination allowed students to compensate in some areas	0 (0)	2 (6.7)	8 (26.7)	14 (46.7)	6 (20.0)
Highlighted areas of weaknesses	0 (0)	1 (3.3)	6 (20.0)	13 (43.3)	10 (33.3)
Examination was intimidating and scary	8 (26.7)	11 (36.7)	10 (33.3)	1 (3.3)	0 (0)
Feedback provided opportunities to learn	0 (0)	0 (0)	9 (30.0)	9 (30.0)	12 (40.0)

**Table 2: Factor loadings for rotated component matrix and internal consistency (Cronbach's alpha) for students' responses to scale assessing the attributes of OSCE (n=30)**

Attributes of OSCE items	Factor 1	Factor 2
Item 1: Examination was fair	0.5884	-0.1565
Item 2: Wide range of learning objectives were covered	0.8950	0.1866
Item 3: Needed more time at stations	0.4106	0.6796
Item 4: Examination was well administered	0.8193	-0.1418
Item 5: Examination was very stressful	-0.2201	0.8369
Item 6: Examination was well structured	0.6865	-0.3131
Item 7: Examination allowed students to compensate in some areas	0.6943	-0.1056
Item 8: Highlighted areas of weaknesses	0.8193	-0.0280
Item 9: Examination was intimidating and scary	-0.0197	0.7646
Item 10: Feedback provided opportunities to learn	0.7896	-0.0118
Eigenvalue	4.32	1.90
Percentage of variance explained	42.84%	19.36%
Cronbach's alpha		0.81



**Figure 1:** Evaluated model of the scale structure generated through structural equation modeling (SEM) Att1-att10: attribute items 1–10 on the scale

good psychometric properties, ensuring its applicability across various medical education settings. However, the limitation of this study was the smaller sample size of medical students. We also could not assess the test–retest reliability given the circumstances in which the assessment was applied.

Despite these limitations, our study has certain important implications for practice and research in medical education. The creation of standardized tools for assessing the evaluation/assessment techniques under medical education has become important, particularly during this era of CBME. We have developed a short and simple scale to assess the attributes of OSCE in a medical education setting. It was also found to have good and reliable psychometric properties, making it applicable to similar settings and assessments. Further modifications can be done to the questionnaire to make it more appropriate based on the departmental setting. However, if these tools are integrated into the routine medical education assessment, we will be able to evaluate the performance of the OSCE/OSPE performed in different departmental settings. Future studies involving a larger number of student sample is required to further validate the scale and make the scale generalizable to the rest of the medical education settings.

**Ethical approval**

Because this study was conducted as a part of the quality improvement process, ethical approval was not obtained. However, consent for participation was obtained from all students before the survey.

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**Conflicts of interest**

There are no conflicts of interest.

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