DOI: 10.7860/JCDR/2025/78821.21171

Original Article

Biochemistry Section

Evaluating Objective Structured Practical Examination as a Formative Assessment Tool in Biochemistry: A Cross-sectional Study from a Medical College in Telangana, India

AMTUL RAHMAN AMBERINA[1], RAVIRALA TAGORE[2], B RAMYA SREE[3]

ABSTRACT

Introduction: National Medical Council (NMC) advocates for Competency-Based Medical Education (CBME). This learner-centred curriculum emphasises continuous assessment that measures competencies and provides feedback. Objective Structured Practical Examination (OSPE) provides an improved objectivity and reliability than conventional assessment method. Thus, the present study was focused to assess cognitive as well as psychomotor domains in 1st-year medical students by implementing modified OSPE.

Aim: To evaluate OSPE module for the comprehensive assessment of both theoretical knowledge and practical skills among Phase 1 medical students in biochemistry, and to evaluate students' perception of the OSPE through a structured questionnaire.

Materials and Methods: This prospective, interventional cross-sectional study was conducted from November 2024 to January 2025 in the Department of Biochemistry at Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India. A total of 126 students were recruited for the study after obtaining institutional ethical clearance (IEC No: 226/OCT/2024). All the students were taught about diabetes mellitus and estimation of Random Blood Sugar (RBS); the procedure was recorded and the video was shared with students through WhatsApp. OSPE stations were organised to estimate the RBS values and students were assessed using a prevalidated checklist. The student feedback on OSPE was solicited through a standardised questionnaire and analysed using Statistical Package for the Social Sciences (SPSS) software version 20.0.

Results: All 126 students (100%) agreed that the OSPE instructions were clear and that the procedural video was helpful. A majority, 120 (95.2%), found the time allotted to be sufficient, while 6 (4.8%) did not. Similarly, 120 (95.2%) students confirmed that the OSPE questions were covered in lectures, and 123 (97.6%) students felt that the OSPE was well organised. Overall, 124 (98.4%) students reported that the OSPE was a valuable learning experience and supported conducting similar sessions regularly. The reliability score was 0.94. The student's performance was very good, with 125 (99.2%) students scored more than 80% in procedure station and more than 75% in response station.

Conclusion: The performance of students in the OSPE was very good, as most students scored good marks and their perception towards OSPE was more positive and opted to conduct regularly. So, the OSPE can be used as an assessment tool in formative assessment.

Keywords: Competency, Curriculum, Performance, Procedure, Random blood sugar

INTRODUCTION

The CBME integrates assessment throughout the learning process and fosters implementation of multimodal assessment methods. This assessment-driven approach ensures that medical professionals acquire necessary competencies, ultimately leading to better patient care outcomes. Conventional assessment methods are hindered by several deficiencies, like bias, subjectivity and limitations [1]. Most of the times after the practical examinations, students complain that they are not scoring good marks though they performed well in the practical examinations. They also usually complain that some students get easy practical task and the other get difficult along with that some students were asked basic questions, while others were asked difficult questions. Even the external examiners have complained about the conventional practical exams as the method is very extensive and time-consuming [2].

In order to have its robust implementation, CBME rationalises that medical graduates are assessed by an objective medical standard which is autonomous of the student performance and OSPE serves as a credible substitute to overcome these challenges [3]. Objective Structured Clinical Exam (OSCE) was introduced by Harden RM et al., to assess clinical competencies and it was modified to assess practical knowledge and skills in preclinical and paraclinical subjects, and named it as (OSPE) [4]. Rowland S et al., identified OSPE as an optimal multilevel evaluation approach [5]. It incorporates four levels of Miller's pyramid: "knows," "knows how," "shows how," and "does" [6]. CBME inherently incorporates assessment as a crucial element. The modes of assessment in medical education have evolved over the years, promotes a cohesive approach to teaching, learning, and evaluation [7].

OSPE is a comprehensive assessment method that evaluates skills, competencies and professionalism in a structured, objective, and standardised manner. It removes bias, ensuring fairness and consistency. It comprises a standard format with multiple assessment stations. The students are assessed by certified assessment facilitators with a prevalidated checklist. With numerous advantages, OSPE has successfully addressed the limitations of conventional evaluation techniques [8].

However, while OSPE evaluates a broad spectrum of competencies, it also has certain constraints. It is a resource-intensive, requires maintenance of consistency across the stations and may contribute to assessor fatigue [9-11]. In most previous studies on OSPE, the theory lectures were not included, and OSPE was commonly used for internal assessment but not in formative assessment [1,2,4]. The present study adapted OSPE design to evaluate

practical biochemistry competencies by using OSPE as a formative assessment tool. The OSPE was modified to include a theoretical lecture on the topic and a practical demonstration was given on the same. Usually, OSPE is conducted only for practical purpose whereas in this study the theory lecture was also incorporated which could help the students in performing better during the OSPE. Thus, the present study aimed to evaluate modified OSPE module for comprehensive assessment of both theoretical and practical skills among Phase 1 medical students in biochemistry and to assess student perceptions of OSPE using a structured questionnaire for Phase 1 medical students in Telangana, India.

MATERIALS AND METHODS

The current study was a prospective, cross-sectional, interventional study conducted from November 2024 to January 2025 in the Department of Biochemistry at Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India involving Phase 1 medical students. The study received approved by the institutional ethical committee (IEC No: 226/Oct/2024).

Inclusion criteria: The phase 1 medical students (1st year MBBS) from the 2024 batch who were voluntarily willing to participate were included in the study.

Exclusion criteria: Students who were not willing to participate, as well as those from other batches and courses, were excluded from the study.

Sample size calculation: Out of 150 1st-year (Phase 1) MBBS students in the academic year 2024, 126 students expressed their willingness to participate in the study.

The chosen topic by the faculty was diabetes mellitus. The topic for didactic lecture was identified from the biochemistry competencies. Learning objectives were defined and lesson plan was designed to cover the learning outcomes. The departmental team formulated the OSPE module to conduct formative assessment on the topic chosen. Well-structured and prevalidated questionnaire and checklist were drafted. A theory lecture was taken on the selected topic for OSPE. The step-by-step procedure was recorded, and the video was shared with all subjects through WhatsApp group.

Three OSPE stations were designed, labelled as procedure, response and rest.

Procedure station: The procedure station was setup for all the students. The scoring was based on the students' preparation before analysis, steps followed to measure blood glucose using glucometer strip method and postprocedure clearing. The procedure was carried out only on students. The total marks allotted were five marks and five minutes time was allotted for each student [Table/Fig-1].

Procedure	Score (5 marks)
Procedure before the analysis	
Check the expiry date of the glucometer strip	½ mark
Clean the patient's finger with alcohol swab	½ mark
Procedure for measuring blood glucose using glucometer strip	
Turn on the capillary glucometer	½ mark
Load a test strip into it	½ mark
Remove the cap of lancet and prick the side of the finger	1 mark
Touch the strip against the drop of the blood to allow it to absorb	½ mark
Apply pressure on the puncture site with gauze	½ mark
Postprocedure	
Note the glucometer reading in the patient's file	½ mark
Discard the lancet and gauze in the waste bin	½ mark

[Table/Fig-1]: Evaluation check list for the RBS procedure for OSPE.

Response station: This station included the prevalidated questionnaire on the topic of diabetes mellitus. A total of four marks were allocated and the time allotted was five minutes for each student [Table/Fig-2].

S. No.	Questionnaire	Score (4 marks)
1	How do you interpret test result	1 mark
2	What are the major types of diabetes	1 mark
3	What are the causes of hyperglycaemia	1 mark
4	What is the importance of HbA1c	1 mark

[Table/Fig-2]: Prevalidated questionnaire used in response station.

In the rest station, students were given two minutes time to analyse their answers. Five similar OSPE modules were setup in five different rooms. Thirty students and one faculty member were assigned to each OSPE room. The faculty assessed the students with the aid of predesigned checklist and allocated marks accordingly. The feedback questionnaire was prepared as per the need of the study and validated by subject experts. The validity score for the questionnaire was 0.72 (Cronbach's Alpha), while the reliability score of feedback questionnaire was 0.94. At the end of session feedback questionnaire was given to students, and the responses were documented and analysed [Table/Fig-3].

S. No.	Question	Yes/No
1	OSPE instructions were clearly explained	
2.	Video recording the OSPE procedure was helpful	
3.	Time allotted was adequate	
4.	Questions were covered during the lecture	
5.	OSPE was well organised	
6.	Was OSPE a good experience	
7.	Did the session aid in learning objectives and competencies of the topic?	
8.	More such sessions regularly	

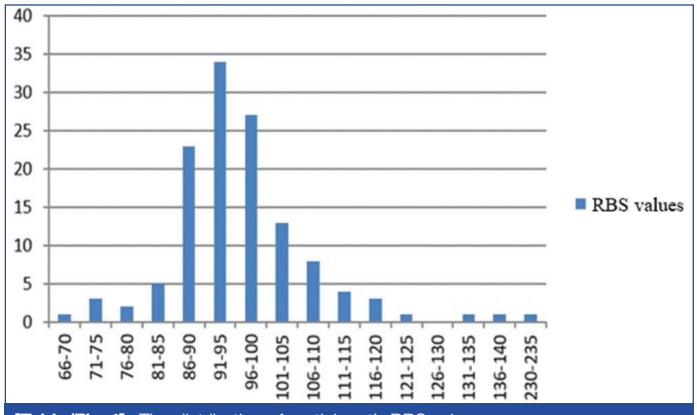
[Table/Fig-3]: Feedback questionnaire provided to the students.

STATISTICAL ANALYSIS

The data were collected and entered into Microsoft Excel sheets and analysed using SPSS version 20.0.

RESULTS

The study enrolled a total of 126 first-year MBBS students, of which 95 (75.40%) were females and 31 (24.60%) were males. The mean age of the students was 18.5±1.5 years. The distribution of students' RBS values is graphically illustrated in [Table/Fig-4]. The mean RBS was 96.62±16.42 mg/dL. The range of the RBS values from 68 to 235 mg/dL. Out of 126 students, one student had an RBS value higher than the reference value and subsequently received a diabetes mellitus diagnosis.



[Table/Fig-4]: The distribution of participant's RBS values.

Student's performance in OSPE: The mean score of the students' performance in procedure station was 4.58±0.52 marks, with the range of 2.5 to 5 marks. Out of 126 students, 125 scored more than 80% in the procedure station, in which 75 (59.52%) students scored 5 marks (100%) and 50 (39.68%) students scored 4 marks (80%). Only 1 (0.8%) student scored 2.5 marks (50%).

In the response station, the students' mean score was 3.54±0.53 marks, with a range of 2.5 to 4 marks. Out of 126 students, 125 scored more than 75% in response station, in which 71 (56.35%) students scored 4 marks (100%) and 55 (43.65%) students scored 3 marks (75%). Only 1 (0.8%) student scored 2.5 marks (50%).

Student's feedback: All 126 (100%) students unanimously agreed that the OSPE instructions were clearly explained, and the video recording of the procedure was very helpful. Out of 126 students, 120 (95.2%) expressed that the time allotted to perform OSPE was sufficient, while only 6 (4.8%) expressed that the time was not sufficient to complete the task. Out of 126 students, 120 (95.2%) students expressed that the questions asked in OSPE were covered in the lecture, and 123 (97.6%) students expressed that the OSPE was well organised. 124 (98.4%) students expressed that the OSPE was a good experience that aided their learning of competencies, and also opted to conduct similar sessions regularly [Table/Fig-5].

S. No.	Question	Yes N (%)	No N (%)
1	OSPE instructions were clearly explained	126 (100)	0
2.	Video recording the OSPE procedure was helpful	126 (100)	0
3.	Time allotted was adequate	120 (95.2)	6 (4.8)
4.	Questions were covered during the lecture	120 (95.2)	6 (4.8)
5.	OSPE was well organised	123 (97.6)	3 (2.4)
6.	Was OSPE a good experience	124 (98.4)	2 (1.6)
7.	Did the session aid in learning objectives and competencies of the topic?	124 (98.4)	2 (1.6)
8.	More such sessions regularly	124 (98.4)	2 (1.6)

[Table/Fig-5]: Response to feedback questionnaire.

DISCUSSION

The main goal of assessment was to evaluate learning outcomes. It assesses the quantity, quality and efficacy of instruction and the capabilities of the students. The assessments typically follow two main forms: formative and summative assessments. Summative assessments examine students' learning at the conclusion of a programme, such as annual examinations, while formative assessments are continuous evaluations conducted during learning process to enhance student comprehension [12]. Conventional assessment methods predominantly emphasise rote memorisation and recall, are susceptible to bias and provide limited feedback. In contrast, a holistic assessment method should integrate the cognitive, psychomotor and affective domains to ensure a more comprehensive evaluation of learner development [13].

In the present study, modified OSPE module was selected to evaluate the formative assessment of theoretical and practical skills among Phase 1 medical students in biochemistry and also to assess student perceptions of OSPE using a structured questionnaire for Phase 1 medical students of Telangana, India. The presents study indicated that 99.2% of students scored more than 80% in procedure station and more than 75% in response station. Thus, the OSPE helps the students to score good percentage in practical examination. These findings were similar with the study by Suneja S and Kaur C, who compared OSPE with Conventional Practical Examination (CPE) in formative assessment and found that the mean score of the students was significantly high in OSPE group compared to CPE group. They also reported that the students as well as faculty both gave positive feedback towards OSPE, as it is more feasible and acceptable in biochemistry formative assessments [13].

The traditional OSPE focuses on skill assessment with less emphasis on knowledge evaluation through recall. The present research study adopted a hybrid OSPE model that integrates both theoretical and practical competencies, thereby enhancing learning outcomes. A previous study by Vivek SM et al., incorporated OSPE to assess practical skills in a formative assessment. The current study leveraged the flexibility of OSPE to assess both the cognitive and psychomotor domains in a formative assessment [14].

The feedback evaluation yielded encouraging results, similar to the findings from studies by Rajan R et al., [15]. A significant majority—98% of students—agreed that OSPE enhanced competency-based learning. These findings were consistent with those of a multidisciplinary study integrating anatomy, physiology and biochemistry conducted by Rajkumar KR et al., [16].

Faculty perception of OSPE was not a research dimension in the present study, although many studies have reported on faculty perceptions [2,17]. The students' perception was assessed by feedback questionnaire and the response was in consistent with previous research by Bairy KL et al., [18]. The majority of students were of the opinion that OSPE was a valuable learning experience and helped bridge the gap between theory and practice. Only 4.8% of respondents reported that the time allotted was insufficient.

The students' feedback response of the present study was compared with other studies [1,4]. The questionnaire was not same in all the studies. In all the studies students were more positive towards OSPE. Most of the students agreed that in the OSPE the time allotment was sufficient, topic or competency was covered in lecture, relevant questions were asked and that it was a good experience and well organised [Table/Fig-6] [1,4].

Author and year	Place	Sample size	Questionnaire	% Agreed
Kundu D et al., 2013 [1]	West Bengal, India	146	The questions asked were relevant	93.15
			Sufficient time was given to students	81.15
			The activity stations that were used to demonstrate skills were relevant	95.20
			OSPE is the same as the earlier pattern of examination	8.21
			OSPE has wide range of knowledge compared with older methods	92.46
			OSPE is stressful compared with the old method	78.08
			OSPE is fair compared with old method	86.30
			OSPE is easier to pass	44.52
			OSPE should be followed as method of assessment in biochemistry	84.24
			Effects of OSPE: Helps to improve	96.57
			Provides chance to score better	76.71
			Application of knowledge in clinical practice	94.52
			OSPE eliminates bias	92.46
Deori R et al., 2024 [4]	Assam, India	161	My experience on OSPE for practical exam was satisfied	93.4
			OSPE improve practical skills better than the traditional method of assessment	98.4
			OSPE improved reasoning skills better than traditional method of assessment	90.1
			OSPE was stress free as compared to VIVA	78.6
			I did not feel threatened of the examiner	67.2
			OSPE removes bias in examination	62.2
			OSPE provides chance to score better as compared to traditional method	82.0
			The time given for stations was adequate	73.8
			Do you agree that OSPE should be incorporated as routine assessment method in biochemistry?	91.8

Present study, 2025	Telangana, India	126	OSPE instructions were clearly explained	100
			Video recording the OSPE procedure was helpful	100
			Time allotted was adequate	95.2
			Questions were covered during the lecture	95.2
			OSPE was well organised	97.6
			Was OSPE a good experience	98.4
			Did the session aid in learning objectives and competencies of the topic?	98.4
			More such sessions regularly	98.4

[Table/Fig-6]: Comparison of the student's feedback response on OSPE in biochemistry with other studies.

OSPE ensures consistent evaluation across students and serves the objective of minimising examiner bias. It is comprehensive and evaluates multiple skills and competencies. Implementing OSPE as an assessment tool reduces anxiety, boosts confidence and fosters improved student performance.

Limitation(s)

The present study focused only on OSPE and did not include a comparison with the CPE. Faculty perception was not included and only students' perception towards this modified OSPE was included in the study.

CONCLUSION(S)

The successful reception of OSPE among students is expected to drive OSPE adoption among faculties. The present research study advocates for the implementation of modified OSPE to effectively combine theoretical knowledge and practical application. This combined approach provides a comprehensive understanding and adapting OSPE design for theory topics as well. The students performance was very good with the modified OSPE, as the students are highly satisfied and opted to conducting it regularly. Thus, the OSPE can be used as assessment tool in formative assessment in future research recommendations.

Future studies can compare OSPE with traditional practical examination and include the perception of the faculty members.

REFERENCES

[1] Kundu D, Mandal T, Osta M, Sen G, Das H, Gautam D. Objective structured practical examination in biochemistry: An experience in Medical College, Kolkata. J Nat Sci Biol Med. 2013;4:103-07.

[2] Sushma BJ, Sumit P. OSPE as an assessment tool for medical students. J Chem Analyt Biochem. 2024;1(1):103. Doi: 10.59462/JCAB.1.1.103.

[3] Shah N, Desai C, Jorwekar G, Badyal D, Singh T. Competency-based medical education: An overview and application in pharmacology. Indian J Pharmacol. 2016;48(Suppl 1):05-09. Available from: https://doi.org/10.4103/0253-7613.193312.

[4] Deori R, Bora K, Das M. Perception of first year MBBS students on objective structured practical examination as an assessment tool in biochemistry. Int J Res Med Sci. 2024;12:461-65.

[5] Rowland S, Ahmed K, Davies DC, Ashrafian H, Patel V, Darzi A, et al. Assessment of anatomical knowledge for clinical practice: Perceptions of clinicians and students. Surg Radiol Anat. 2011;33:263-69. Available from: https://doi.org/10.1007/s00276-010-0748-8.

[6] Ten Cate O, Carraccio C, Damodaran A, Gofton W, Hamstra SJ, Hart DE, et al. Entrustment decision making: Extending Miller's pyramid. Acad Med. 2021;96(2):199-204. Doi: 10.1097/ACM.0000000000003800.

[7] Roy H, Ghosal AK, Ray K. Students' perception on 'Objective Structured Practical Examination (OSPE)' in internal assessment examination of anatomy. Int J Sci Res. 2019;8:30-32.

[8] Rai N, Nair SK. Evaluation of perception regarding feasibility of introducing Objective Structured Practical Examination (OSPE) in the department of anatomy. Indian J Clin Anat Physiol. 2019;6(3):315-20.

[9] Charles J, Janagond A, Thilagavathy, Rajendran, Ramesh, Vidhya. Evaluation by OSPE (objective structured practical examination)-A good tool for assessment of medical undergraduates-A study report from Velammal Medical College, Madurai, Tamil Nadu, India. IOSR-JRME. 2006;6:01-06.

[10] Gitanjali B. The other side of OSPE. Indian J Pharmacol. 2004;36:388-89.

[11] Biggs J. Teaching for quality learning at University. The Society for Research into Higher Education & Open University Press; 2003.

[12] Ashok NS, Prathab AG, Indumathi VA. objective structured practical examination as a tool for evaluating competency in Gram staining. J Educational Res & Med Teach. 2013;1(1):48-50.

[13] Suneja S, Kaur C. Objective Structured Practical Examination (OSPE) for formative assessment of medical undergraduates in Biochemistry. Nat Med J India. 2024;37(5):261-66. Doi: 10.25259/NMJI_2022.

[14] Vivek SM, Neeru G, Vipin KG, Gargi S. Study of OSPE as a method of assessment in the anatomy: Implementation and attitude among MBBS students. Int J Anat Res. 2024;12(2):8910-16. Doi: 10.16965/ijar.2024.11.

[15] Ranjan R, Jain A, Bhujade R. OSPE in anatomy: New dimensions in assessment. Int J Anat Res. 2016;4(1):1789-94. Available from: https://doi.org/10.16965/ijar.2015.336.

[16] Rajkumar KR, Prakash KG, Saniya K, Kumar SS, Pradeep VP. OSPE in anatomy, physiology and biochemistry practical examinations: Perception of MBBS students. Indian J Clin Anat Physiol. 2016;3(4):482-84. Available from: https://doi.org/10.5958/2394-2126.2016.00111.0.

[17] Manju C, Madhur G. Perception of students and faculties about Objective Structured Practical Examination (OSPE) as a method of assessment of competence in biochemistry as against the conventional method. Int J Curr Med Pharamceut Res. 2019;5(06):4319-21.

[18] Bairy KL, Shalini A, Smita S, Bharti CM, Mohan A, Meena KK et al. OSPE in pharmacology: Comparison with the conventional method and students' perspective towards OSPE. British Biomedical Bulletin. 2014;2(1):218-22.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Biochemistry, Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India.
2. Professor and Head, Department of Biochemistry, Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India.
3. Postgraduate Student, Department of Biochemistry, Mahavir Institute of Medical Sciences, Vikarabad, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Amtul Rahman Amberina,
Associate Professor, Department of Biochemistry, Mahavir Institute of Medical Sciences, Vikarabad-501101, Telangana, India.
E-mail: dramtull@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Feb 27, 2025
- Manual Googling: May 21, 2025
- iThenticate Software: May 27, 2025 (3%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Feb 25, 2025**
Date of Peer Review: **Apr 13, 2025**
Date of Acceptance: **May 29, 2025**
Date of Publishing: **Jul 01, 2025**