

Original Research Article

Enhancing competency based practical assessment in diploma medical laboratory technology: a prospective comparative study of objective structured practical examination and conventional assessment

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ABSTRACT

Background: Competency-based education emphasizes acquisition of practical skills alongside theoretical knowledge. Conventional practical examinations in diploma in medical laboratory technology (DMLT) programs may be affected by subjectivity, examiner variability and limited assessment of procedural competencies. Objective structured practical examination (OSPE) offers a standardized approach to practical assessment. This study compared OSPE with conventional practical assessment among DMLT students.

Methods: This prospective educational interventional pilot study was conducted among 50 second-year DMLT students in the department of pathology of a tertiary care teaching institution from May 2025 to October 2025. Following routine teaching on peripheral blood smear preparation, students underwent conventional practical assessment followed one week later by a five-station OSPE. Performance was compared using paired Student's t-test, and student perceptions were assessed using a structured feedback questionnaire.

Results: The mean OSPE score was significantly higher than the conventional practical examination score (35.2 ± 4.8 vs 29.6 ± 2.1 ; $p < 0.001$). Forty-two (84%) students scored higher in the OSPE, five (10%) achieved comparable scores and three (6%) scored lower. Students reported favourable perceptions regarding fairness, objectivity, transparency, confidence and educational value.

Conclusion: OSPE provided an objective and structured method for assessing practical competencies among DMLT students and was associated with better performance and favourable learner perceptions. Its use may strengthen competency-based practical assessment in laboratory education.

Keywords: OSPE, Competency-based education, Practical assessment, DMLT, Medical education, Laboratory skills

INTRODUCTION

The quality of healthcare delivery is intrinsically dependent on the competence of healthcare professionals, with medical laboratory personnel playing a pivotal role in disease diagnosis, therapeutic monitoring, and clinical decision-making. Laboratory investigations contribute to nearly 70% of clinical decisions, underscoring the necessity of producing technically proficient and

competent laboratory professionals through effective educational and assessment strategies.^{1,2} DMLT programmes are designed to equip students with the theoretical knowledge, psychomotor skills, analytical ability, and professional attitudes required for accurate laboratory practice.^{2,3} Consequently, assessment methods must not only evaluate knowledge acquisition but also objectively measure practical competence and readiness for routine clinical responsibilities.³

The recent shift towards competency-based education (CBE) has fundamentally transformed health professions education worldwide.⁴⁻⁶ Unlike traditional educational models that primarily emphasize knowledge acquisition, competency-based education focus on measurable learning outcomes, skill acquisition, clinical reasoning, communication, and professionalism.^{4,5} This educational paradigm has been widely adopted in undergraduate and postgraduate medical education because it ensures that graduates possess the competencies required for safe and effective patient care.^{5,6} Within this framework, assessment is regarded not merely as a method of grading students but as an essential component of the learning process that drives competency development through continuous feedback and objective evaluation.

Despite these educational reforms, practical assessment in many DMLT institutions continues to rely predominantly on conventional practical examinations. Conventional practical assessments generally consist of specimen preparation, slide interpretation and viva voce examinations conducted by individual examiners. Although these methods have been used for decades, they are frequently criticized for their inherent subjectivity, examiner bias, inconsistent questioning, variable marking schemes and inadequate assessment of the broad spectrum of competencies expected from laboratory professionals.^{7,8} Students are often evaluated by different examiners under varying circumstances, resulting in poor standardization and limited reliability. Furthermore, conventional practical examinations tend to assess only the final outcome rather than the sequential steps involved in performing laboratory procedures, thereby overlooking essential psychomotor and procedural competencies.⁸

To address these limitations, structured assessment methods have been increasingly introduced into health professions education. Among these, the OSPE, first proposed as an adaptation of the OSCE, has emerged as one of the most reliable and objective tools for assessing practical competencies in laboratory-based disciplines.⁹⁻¹¹ OSPE consists of a series of carefully designed stations, each evaluating a specific practical skill or competency using standardized tasks and predetermined checklists. Every student performs identical tasks under uniform conditions, thereby minimizing examiner variability and ensuring greater fairness, transparency and reproducibility of assessment.^{9,10} Unlike conventional examinations, OSPE enables simultaneous evaluation of cognitive knowledge, psychomotor skills, problem-solving ability, communication and professional behavior within a single examination format.^{10,11}

Over the past two decades, numerous studies have demonstrated the educational advantage of OSPE in medical, dental, nursing and allied health sciences.¹⁰⁻¹³ Previous investigations have consistently reported that OSPE improves the objectivity, reliability and validity of practical assessment while promoting active learning and student engagement. Structured checklists reduce observer

bias, facilitate comprehensive evaluation of procedural skills, and provide constructive feedback that enhances future performance.¹¹⁻¹³ Students generally perceive OSPE as a fairer assessment strategy because every candidate is assessed using identical criteria, whereas examiners appreciate its transparency and reproducibility. Furthermore, OSPE aligns closely with the principles of competency-based education by evaluating students across multiple domains of learning rather than relying solely on factual recall.

In pathology and laboratory medicine education, OSPE has been successfully implemented for the assessment of peripheral blood smear preparation, hematology procedures, clinical biochemistry techniques, microbiological investigations, histopathological specimen handling, and laboratory quality assurance practices.¹²⁻¹⁴ Several studies conducted in undergraduate medical education have demonstrated significantly higher student satisfaction and improved academic performance following the introduction of OSPE.^{13,14} Similar findings have also been reported among nursing, physiotherapy and dental students where structured practical examinations have been shown to improve both learning outcomes and examination reliability. Nevertheless, the majority of published evidence originates from MBBS or other professional degree programmes, while literature focusing specifically on diploma in medical laboratory technology education remains relatively scarce.^{14,15}

The DMLT curriculum places considerable emphasis on the acquisition of practical laboratory competencies because graduates are expected to perform diagnostic procedures independently in hospitals, diagnostic centres and public health laboratories. Skills such as specimen handling, peripheral blood smear preparation, staining techniques, microscopy, quality control and interpretation of laboratory findings require repeated practice and objective evaluation to ensure competency. Given the highly practical nature of laboratory medicine, there is an increasing need to adopt standardized assessment methods that accurately reflect students' technical proficiency and readiness for professional practice. However, evidence regarding the feasibility, effectiveness and acceptability of OSPE among DMLT students, particularly within resource- constrained educational settings in India, remains limited.

The present prospective pilot study was therefore undertaken to compare the effectiveness of OSPE with conventional practical assessment among second-year DMLT students undergoing practical training in hematology. Student performance in both assessment methods was compared using standardized evaluation criteria, and learners' perceptions regarding the acceptability and educational value of OSPE was also assessed. It was hypothesized that OSPE would provide a more objective, reliable and competency-oriented assessment of practical skills than conventional practical examinations. The findings of this study are expected to

contribute to the growing body of evidence supporting competency-based assessment in allied health sciences and may assist educators and curriculum planners in strengthening practical evaluation strategies within DMLT programmes.¹³⁻¹⁵

Aim

To compare the effectiveness of the OSPE with the conventional practical examination in assessing practical competencies among second-year DMLT.

Objectives

Primary objective

To compare the practical examination scores of second-year DMLT students obtained through the OSPE and the conventional practical examination.

Secondary objectives

To evaluate the effectiveness of OSPE as an objective and structured method for assessing practical competencies in hematology. To assess students' perceptions regarding the fairness, objectivity, acceptability and educational value of the OSPE. To determine the feasibility of implementing OSPE as a routine practical assessment tool in DMLT curriculum.

METHODS

Study design and setting

A prospective, single-centre, educational interventional pilot study was conducted in the Department of Pathology of a tertiary care teaching institution over a period of 6 months. The study was designed to compare the effectiveness of the OSPE with the conventional practical examination in assessing practical competencies among DMLT students. The study was carried out in accordance with the principles of competency-based education, with emphasis on objective assessment of practical skills in hematology.

Study participants

The study included second year DMLT students who had completed the scheduled practical teaching sessions on peripheral blood smear (PBS) preparation as prescribed in the institutional curriculum. A total of 50 students fulfilled the eligibility criteria and were enrolled in the study after obtaining written informed consent. Participation was voluntary and students were assured that refusal to participate would not effect their academic evaluation.

Inclusion criteria

Second year DMLT students enrolled in the institution during the study period.

Students who had successfully completed routine classroom teaching and practical demonstrations on peripheral blood smear preparation and staining techniques.

Students willing to participate and who provided written informed consent.

Exclusion criteria

Students absent during either the conventional practical examination or the OSPE. Students who declined participation or withdrew consent at any stage of the study. Students with incomplete assessment records.

Educational intervention

Before assessment, all participants underwent routine practical teaching conducted by experienced faculty members following the standard DMLT curriculum. Using the OSPE, a structured assessment method widely employed in competency-based medical education.^{16,17} Teaching sessions included lectures, live demonstrations, supervised practical exercises and revision sessions covering peripheral blood smear preparation, Leishman staining, microscope handling, identification of normal blood cell morphology and interpretation of peripheral blood smears.

Following completion of routine teaching, students first appeared for the conventional practical examination, which represent the existing institutional methods of practical assessment. After an interval of one week, the same group of students underwent assessment using the OSPE. The one-week interval was maintained to minimize recall bias while ensuring that the acquired knowledge and practical skills were retained.

Conventional practical examination

The conventional practical examination was conducted according to the standard institutional assessment protocol. Students were individually evaluated by faculty members on peripheral blood smear preparation, smear quality, staining characteristics, microscope handling, slide interpretation, and viva voce. Assessment was based on the examiner's overall judgement and institutional marking scheme. Although predefined criteria were available, examiner discretion contributed to variations in questioning, emphasis and scoring.

Objective structured practical examination

The OSPE consisted of five structured stations designed to assess different domains of practical competency. Each station evaluated using validated structured checklists developed according to established OSPE principles.¹⁶⁻¹⁸ The stations were arranged sequentially and every student rotated through each station under identical examination conditions.

The five OSPE stations include.

Station 1

Peripheral blood smear preparation, assessing specimen handling, smear technique, wedge angle, smear thickness and overall smear quality.

Station 2

Leishman staining procedure, evaluating fixation, staining technique, buffer preparation, washing, drying and quality of staining.

Station 3

Spotter station, assessing identification of laboratory equipment, reagents, hematological slides and commonly encountered laboratory specimens.

Station 4

Peripheral blood smear interpretation, requiring students to identify blood cell morphology, recognize abnormal findings and provide appropriate laboratory interpretation.

Station 5

Microscopy and structured viva voce, evaluating microscope handling, focusing techniques, systematic examination of smears, analytical reasoning and application of theoretical knowledge to practical scenarios.

Each station was allotted equal time, and performance was assessed using validated structured checklists developed by departmental faculty members. Individual checklists items carried predetermined marks, thereby minimizing examiner subjectivity and ensuring uniform assessment of all participants.

Feedback assessment

Immediately after completion of the OSPE students completed a structured feedback questionnaire based on a five-point Likert scale ranging from “strongly disagree” to “strongly agree”. Using a validated five-point Likert scale, which has been widely used in educational research to evaluate learner perceptions [18]. The questionnaire assessed students’ perceptions regarding fairness, objectivity, transparency, ease of understanding, reduction of examination stress, adequacy of time allocation, overall satisfaction and educational usefulness of the OSPE. Responses were collected anonymously to encourage honest feedback.

Outcome measures

The primary outcome measure was the comparison of student performances between the conventional practical

examination and the OSPE, as measured by total assessment scores.

Secondary outcome measures included evaluation of students’ perceptions regarding the acceptability, objectivity, reliability and educational value of the OSPE.

Statistical analysis

Data were entered into Microsoft Excel and subsequently analysed using Statistical Package for the Social Sciences (SPSS) software (IBM SPSS Statistics, version 26.0, IBM Corp. Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables were presented as frequencies and percentages.

The normality of score distribution was assessed before comparative analysis. Since the same participants underwent both assessment methods, comparison of mean scores between the conventional practical examination and the OSPE was performed using the paired Student’s t-test. A two-tailed p value of less than 0.05 was considered statistically significant.

Ethical considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Institutional permission was obtained before commencement of the study. Written informed consent was obtained from all participants after explaining the objectives and methodology of the study. Confidentiality of student and assessment scores was strictly maintained throughout the study. Participation was entirely voluntary, and students were free to withdraw from the study at any stage without any academic consequences.

RESULTS

A total of 50 second year DMLT students participated in the study. All enrolled students successfully completed both the conventional practical examination and the OSPE, resulting in a response rate of 100%. No participant was excluded because of absenteeism or incomplete assessment.

Comparison of performance between conventional practical examination and OSPE

The descriptive statistics of student performance in both assessment methods are presented in Table 1. In the conventional practical examination, the scores ranged from 25-34, with a mean score of 29.6 ± 2.1 . In contrast, the OSPE scores ranged from 20-42, with a significantly higher mean score of 35.2 ± 4.8 .

Comparison of mean scores using the paired Student’s t-test demonstrated a statistically significant difference

between the two assessment methods ($t=8.72$ $p<0.001$), indicating superior student performance during the OSPE.

Distribution of student performance

Among the 50 students, 42 (84%) obtained higher scores in the OSPE than in the conventional practical examination. Five students (10%) achieved comparable scores in both assessments, whereas only three students (6%) scored lower in the OSPE.

These findings indicate that the majority of students performed better under the structured assessment format provided by the OSPE.

Comparison of mean scores

The difference in mean scores between the two assessment methods is illustrated in Table 3. Students achieved a mean score of 29.6 ± 2.1 in the conventional practical examination compared with 35.2 ± 4.8 in the OSPE.

Application of the paired Student's t-test demonstrated a highly statistically significant improvement in performance during the OSPE ($t=8.72$, $p<0.001$).

Graphical representation

The comparative mean scores obtained in the conventional practical examination and the OSPE are depicted in Figure 1, demonstrating the higher average performance achieved during the structural assessment.

The distribution of students according to their relative performance in the OSPE is presented in Figure 2. The majority of participants (84%) demonstrated improved performance in the OSPE, whereas only a small proportion achieved similar (10%) or lower (6%) scores than in the conventional assessment.

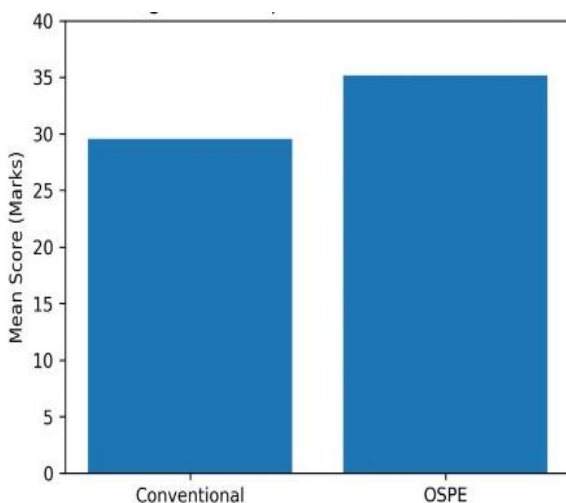


Figure 1: Comparison of mean scores obtained in the conventional practical examination and OSPE.

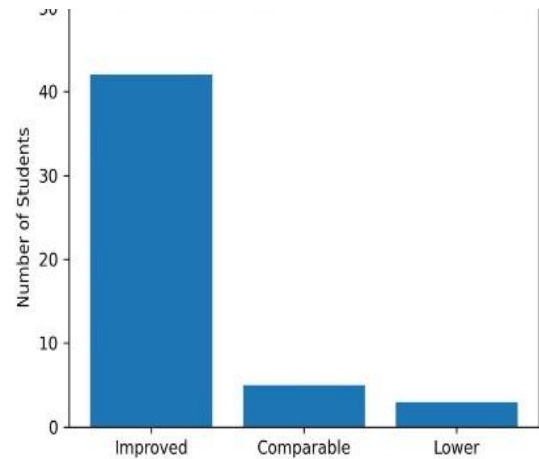


Figure 2: Distribution of students according to comparative performance in the OSPE.

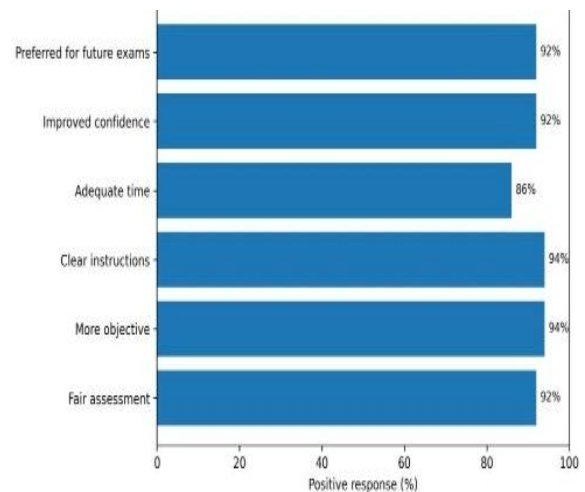


Figure 3: Overall student perception regarding OSPE.

Student's perception regarding OSPE

Student feedback demonstrated a high level of acceptance of the OSPE. Most participants perceived OSPE as a fair, objective, and transparent method of practical assessment. 46 students (92%) either agreed or strongly agreed that OSPE provided a fair evaluation of their practical skills, while 47 students (94%) considered it more objective than the conventional practical examination.

Nearly all participants reported that the station instructions were clear and easy to follow. A majority of students also felt that OSPE enhanced their confidence in performing laboratory procedures and expressed a preference for incorporating OSPE into future practical examinations.

Student's positive perception regarding the OSPE was that the majority of participants reported favourable perceptions of OSPE, with over 90% considering it a fair, objective and effective method of practical assessment. 86% of students agreed that the time allotted at each station was adequate.

Table 1: Demographic characteristics of study participants (n=50).

Demographic characteristics	Category	Number (n)	Percentage (%)
Age (in years)	Mean age: 20	50	100.0
Sex	Male	30	60.0
	Female	20	40.0
Total	-	50	100.0

Table 2: Comparison of conventional practical examination and OSPE scores (n=50).

Parameters	Conventional practical examination	OSPE
Number of students	50	50
Minimum score	25	20
Maximum score	34	42
Mean $\pm$ -SD	29.6 $\pm$ -2.1	35.2 $\pm$ -4.8
Statistical test	-	Paired Student's <i>t</i> -test
P value	-	<0.001

Table 3: Distribution of students according to comparative performance in OSPE (n=50).

Performance categories	Number of students	Percentage (%)
Higher score in OSPE	42	84.0
Comparable score	5	10.0
Lower score in OSPE	3	6.0
Total	50	100.0

Table 4: Comparison of mean scores obtained in conventional practical examination and OSPE.

Assessment methods	Mean $\pm$ SD	t value
Conventional practical examination	29.6 $\pm$ 2.1	8.72
OSPE	35.2 $\pm$ 4.8	

Table 5: Student's perception regarding the OSPE (n=50).

Statements	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
OSPE was a fair method of assessment	28 (56.0)	18 (36.0)	3 (6.0)	1 (2.0)	
OSPE was more objective than conventional practical examination	31 (62.0)	16 (32.0)	2 (4.0)	1 (2.0)	
Instructions at each station was clear and easy to understand	30 (60.0)	17 (34.0)	2 (4.0)	1 (2.0)	
Time allotted for each station was adequate	24 (48.0)	19 (38.0)	5 (10.0)	2 (4.0)	
OSPE improved my confidence in performing laboratory procedures	26 (52.0)	20 (40.0)	3 (6.0)	1 (2.0)	
I would prefer OSPE for future practical examinations	29 (58.0)	17 (34.0)	3 (6.0)	1 (2.0)	

DISCUSSION

Assessment plays a central role in competency-based health professions education because it determines whether students have acquired the knowledge, technical

skills and professional competencies required for safe clinical practice. An ideal assessment method should be objective, reliable, valid, reproducible and capable of evaluating multiple domains of learning. Traditional practical examinations, although widely practiced in

laboratory education, frequently suffer from examiner bias, inconsistent questioning and variable scoring systems. These limitations have prompted increasing adoption of structured assessments methods such as the OSPE which provides standardized evaluation through predetermined tasks and validated checklists.¹⁹⁻²² The present prospective pilot study demonstrated that OSPE was significantly more effective than the conventional practical examination in assessing practical competencies among DMLT students. The mean score obtained during the OSPE (35.2+/-4.8) was significantly higher than that of the conventional practical examination (29.6+/-2.1), with statistically analysis confirming a highly significant difference ($p<0.001$). Furthermore, 84% of students achieved higher scored during the OSPE, indicating that the structured assessment method facilitated better demonstration of practical competence. These findings support the hypothesis that OSPE provides a more objective and comprehensive evaluation of laboratory skills than traditional assessment methods.²³⁻²⁶ The improved performance observed in the present study may be attributed to several inherent advantages of the OSPE. Unlike conventional examinations, where assessment often depends upon examiner discretion and variability in questioning, OSPE utilizes standardized checklists for every candidate. This structured approach minimizes subjective bias while ensuring that all students are assessed under comparable conditions. The checklist-based evaluation also allows examiners to assess individual procedural steps rather than relying solely on the final outcome, thereby providing a more comprehensive assessment of psychomotor skills and technical competence.²⁷⁻³⁰

The findings are consistent with those reported by Suneja and Kaur, who demonstrated that OSPE significantly improved objectivity, transparency and student satisfaction during formative assessment in biochemistry. Similarly, Makwana et al observed higher student performance and greater acceptance of OSPE compared with conventional practical examinations in physiology. Their study concluded that structured practical assessment enhanced both learning outcomes and examination reliability, findings that closely parallel those observed in the present investigation.³¹⁻³⁴ Comparable results have also been reported by Patel et al who evaluated OSPE in pathology practical examinations among undergraduate medical students. They found significantly higher examination scores together with greater student confidence and satisfactions following implementation of OSPE. Likewise, Bhagat et al reported that OSPE encouraged active learning, improved procedural competence and prompted better retention of practical skills through structured assessment and immediate feedback. These studies collectively reinforce the growing evidence supporting OSPE as a reliable assessment strategy across multiple disciplines within medical education.³⁵⁻³⁷ The present study also demonstrated overwhelmingly positive student perceptions regarding the OSPE. More than 90% of participants considered OSPE to

be fair, objective, transparent and preferable to the conventional practical examination. Most students also agreed that the structured stations enhanced their confidence while performing laboratory procedures. These findings are consistent with previous educational research, which has consistently shown that students appreciate standardized assessment methods because they reduce examiner bias and improve performance transparency. Positive student perception is particularly important because assessment strategies significantly influence learning behavior and motivation.

One of the major strengths of the OSPE lies in its ability to evaluate multiple competencies within a single examination. Each station in the present study assessed a different component of laboratory practice, including peripheral blood smear examination, staining technique, spotter identification, smear interpretation and microscopy. This multidimensional assessment is more representative of real laboratory practice than conventional examinations, which frequently emphasize only a limited number of practical skills. Consequently, OSPE aligns closely with the principles of competency-based education by evaluating cognitive, psychomotor, analytical and communication domains simultaneously.

Another important observation was the feasibility of implementing OSPE within the existing institutional infrastructure. Although structured examinations require careful planning, checklist preparation, faculty orientation and station organization the examination was successfully conducted without major logistical difficulties. This finding suggests that even resource constrained institutions can effectively implement OSPE with appropriate planning and faculty commitment. The growing emphasis on competency-based curricula in India further strengthens the need for structured assessment methods that objectively evaluate practical competencies.³⁸⁻⁴⁰

Despite its advantage, implementation of OSPE is not without challenges. Preparation of standardized stations and validated checklists requires considerable faculty effort and coordination. Additional manpower, logistics and examination space may also be necessary, particularly when assessing large student batches. Furthermore, initial faculty training is essential to ensure uniform implementation and maintenance of assessment quality. Nevertheless, these challenges are largely organizational and are outweighed by the substantial educational benefits offered by structural assessment.

The present study possesses several strengths. It prospectively compared two assessment methods within the same group of students, thereby minimizing intergroup variability. The use of standardized checklists and paired statistical analysis strengthened the validity of the findings. In addition, student feedback regarding the acceptability of OSPE provided valuable insights into learner perspectives, supporting the educational feasibility of this assessment method.

However, certain limitations should be acknowledged. This study was conducted at single institution with a relatively small sample size, which may limit the generalizability of the findings. Furthermore, only one practical topic-peripheral blood smear preparation and interpretation-was evaluated. Further multicentric studies involving larger student populations and multiple laboratory disciplines are required to establish the long-term educational impact, reliability and cost effectiveness of OSPE across diverse healthcare education settings.

Overall, the findings of the present study provide further evidence supporting the integration of OSPE into competency-based DMLT curricula. Adoption of structured practical assessment has the potential to improve the quality, objectivity and reliability of competency evaluation while simultaneously promoting active learning and professional skill development among future laboratory technologists.

Limitations

This study has certain limitations. It was conducted at a single institution with a relatively small sample size of 50 students, which may limit the generalizability of the findings. Furthermore, the assessment focused on a single practical topic, namely peripheral blood smear preparation and interpretation, and therefore may not represent competencies across all areas of laboratory medicine. This study also evaluated immediate examination performance and student perceptions; long-term retention of practical skills and the sustained educational impact of OSPE were not assessed. Multicentric studies involving larger student populations and multiple laboratory disciplines are required to further establish the effectiveness, reliability and feasibility of OSPE.

CONCLUSION

OSPE demonstrated significantly better student performance compared with conventional practical assessment and was well accepted by DMLT students. Its standardized stations and structured checklists provided a more objective, transparent and comprehensive assessment of practical competencies. OSPE therefore represents a useful approach for competency-based practical assessment in DMLT education. Its wider implementation may strengthen the quality and reliability of practical evaluation and promote better demonstration of laboratory skills.

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