INSTRUCTIONAL DESIGN AND ASSESSMENT

An Objective Structured Clinical Examination to Assess Problem-Based Learning

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Objectives. To compare pharmacy students' performance on an objective structured clinical examination (OSCE) to their performance on a written examination for the assessment of problem-based learning (PBL); and to determine students' and faculty members' perceptions of OSCEs for PBL evaluations.

Design. Four OSCEs were added to the written examination to assess 4 PBL cases in a third-year pharmacotherapy course. OSCE scores were compared to written examination scores. Faculty members evaluated student performance.

Assessment. OSCE performance did not correlate with the written-examination scores. Most students ($\geq 75\%$) agreed that OSCEs reflected their learning from PBL and measured knowledge, communication, and clinical skills. A majority of faculty members ($\geq 75\%$) agreed that OSCEs should be part of PBL assessment.

Conclusions. Addition of an OSCE to written examinations was valued and provided a more comprehensive assessment of the PBL experience.

Keywords: objective structured clinical examination, problem-based learning, pharmacy students, assessment, competency, examination

INTRODUCTION

The culture of pharmacy education is evolving to embrace the core competencies set forth by the Accreditation Council for Pharmacy Education (ACPE)¹ and the Center for the Advancement of Pharmacy Education.² Recommendations on the strategies to improve student proficiency in the areas of patient-centered care, population-based care, and systems management have been established to guide academics in developing curricula focused on the changing practice of pharmacy.³ Additionally, the integration of active learning in curricula has been identified as a strategy essential to enhancing knowledge and self-directed learning skills and advancing

problem-solving skills. Professionalism, leadership and advocacy, collaboration, and cultural competency need to be infused in the pharmacy curriculum.

Problem-based learning (PBL) is an andragogical strategy that implements an active student-directed approach to learning and has been adopted in some form by 71% of US pharmacy colleges and schools.^{3,4} During PBL, students develop problem-solving skills, formulate evidence-based decisions, and enhance their communication skills;^{3,5-7} all of which are abilities essential to achieving core competencies.¹⁻² Additional competencies addressed include improving independent and team-directed learning, developing the ability to obtain and evaluate literature, and ultimately applying this information to patient cases.³

According to the ACPE, assessment and evaluation of these core competencies are necessary and critical to provide accountability for the goals of pharmacy education.¹ One of the challenges pharmacy educators face is determining the most effective and reliable method to evaluate the PBL experience.⁶ Assessment of student

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learning with PBL includes traditional testing tools, such as multiple-choice and short-answer examinations, surveys, and facilitator, group, peer and self-evaluations.^{5,6,8-10} These tools determine students' knowledge and problem-solving abilities but do not evaluate students' clinical competence or their ability to effectively communicate their knowledge in a pharmacy practice setting.^{11,12}

Objective structured clinical examination (OSCE) is a well-established tool for assessing clinical competence because it is a performance-based test that evaluates clinical knowledge, professional judgment, communication, interpersonal skills, problem-solving skills, and resolution development.¹³⁻¹⁷ In a 2009 survey of US colleges and schools of pharmacy, Sturpe identified 32 programs using OSCEs, only 4 of which incorporated OSCE as an assessment tool in therapeutic courses.¹⁸ Pharmacy OSCEs are also frequently used in laboratory courses, advanced pharmacy practice experience (APPE), yearly summative examinations,^{11,19-20} continuing education,²¹ and licensure.^{13,18} Medical schools have used OSCEs as a component to evaluate PBL for decades.²²⁻²⁴ No published reports were found of pharmacy schools using OSCEs to assess the PBL experience.

At Wayne State University (WSU), Eugene Applebaum College of Pharmacy and Health Sciences, PBL represents 20% to 40% of the second and third years of the PharmD curriculum. Standard multiple-choice and short-answer examinations, quizzes, and self-evaluations were the only tools used to assess PBL learning outcomes. Traditionally, OSCEs have been used at WSU in the first and second years of the curriculum to assess competencies for patient-care laboratories. An OSCE was introduced to assess PBL in the final pharmacotherapeutics module of the third year of the PharmD program. In an effort to demonstrate achievement of the competencies derived from social-learning theories²⁵ and the taxonomy of significant learning,²⁶ and, as required by ACPE, our team introduced an OSCE to assess these competencies during PBL. The purpose of this study was threefold: (1) to quantify student performance on the OSCEs in the areas of knowledge, clinical skills, and social skills; (2) to compare OSCE performance to the traditional multiple-choice written examination for the evaluation of student learning; and (3) to explore the perceptions of faculty members and students on the use of OSCEs to test knowledge, clinical skills, and communications, as well as their thoughts on OSCE examination logistics.

DESIGN

All PBL components of the curriculum were designed to incorporate cognitive²⁷ and significant learning²⁶ related to the competencies of pharmacy practice.

OSCEs were added as a summative assessment tool to evaluate competencies generally not assessed by multiple-choice examinations. A quantitative methodology was used to assess performance on the OSCEs and then to compare this to traditional multiple-choice examinations. Because the assessment tools measure different competencies, a moderate correlation between the OSCE and the multiple-choice examination was predicted. A survey was conducted to collect data on the effectiveness of OSCEs as a summative evaluation tool for PBL and for quality-improvement purposes. In the following sections, a detailed description of the development of the PBL cases, OSCE cases, and multiple-choice tests is presented.

Pharmacotherapy Module and PBL

PBL was integrated into 8 pharmacotherapy modules offered during years 2 and 3 of the PharmD curriculum. Specifically, PBL occupied 20% (2 cases) of the first 7 modules and 40% (4 cases) of the final module. All modules were disease-state oriented, combining principles of pharmaceutics, pharmacology, medicinal chemistry, and pharmacotherapy with corresponding PBL experiences in a case-based format. Module 8 focused on special patient populations, including pediatrics (5 hours), geriatrics (5 hours), women's health (11.5 hours), men's health (2 hours), and cultural competency (2.5 hours). In this study, 60 third-year pharmacy students participated.

The 4 PBL cases were developed by the research team, which included the module coordinator, and 3 faculty content experts. The cases covered a topic not otherwise taught in the lecture portion of the course. One case was assigned per special-patient population category with cultural competency integrated into the women's health case. All 4 cases also incorporated pharmacotherapy topics covered in the other 7 modules as a summative comprehensive review of important concepts needed to prepare students for fourth-year practice experiences.

In module 8, the rollout of the 4 PBL cases was accelerated to accommodate twice as many cases as in modules 1 through 7. The standard PBL process requires 3 learning sessions. The first case followed the standard PBL process, as found in modules 1 through 7 spanning 3 weeks. During session 1, students met in their assigned groups with a facilitator to discuss the case and generate learning objectives. The second nonfacilitated session, which was optional, offered students an opportunity to work alone or in their groups outside of the classroom to fulfill the learning objectives and identify and resolve drug-related problems (DRPs). A quiz was given at the beginning of the third session as a formative check on individual progress. The third PBL session was a facilitated student discussion of learning objectives, including

resolution of DRPs. The second and third PBL cases followed the same structure but were completed in 2 consecutive weeks. The fourth PBL case was a self-directed learning experience without scheduled facilitated discussions, group meetings, or input from other students or faculty members. The fourth case was distributed to students at the beginning of the module to complete at their own pace. Assessment of the final case using both the OSCE and the multiple-choice examination was embedded in the summative evaluation of the course.

Development of PBL, OSCE, and the Written Examination

Outcomes for PBL were assessed using both a 4-station OSCE and a 40-item multiple-choice examination. The 4 OSCE stations were developed to correspond to each PBL case. The patients described in the PBL cases remained the same, but new DRPs were created in the development of each OSCE.

The OSCE cases were purposefully designed to be complex cases because the students had specific learning objectives that prepared them for the OSCE scenarios. Three of the 4 OSCE stations were interactions between students and standardized patients, and the fourth case was an interaction between students and a standardized physician. Each OSCE case consisted of only 1 DRP or 1 task to be performed. All 4 patients and problems were complex because the patients presented with emotional or functional issues, and the problems were embedded in multiple disease states. For example, the geriatric case involved an older woman who had macular degeneration, was receiving warfarin for atrial fibrillation, and had developed a urinary tract infection. The patient in the scenario presented with a new prescription for sulfamethoxazole-trimethoprim to a community pharmacy. Students were to identify and resolve the drug-drug interaction between warfarin and sulfamethoxazole-trimethoprim and accommodate the patient's and her daughter's time constraints. To integrate cultural competency, the woman's health case involved a pregnant Hispanic woman with newly diagnosed hypertension. The student was expected to identify a contraindication with the prescribed antihypertensive agent (lisinopril) and discuss the DRP and resolution with the obstetrics/gynecology medical resident.

Each faculty investigator/content expert developed her OSCE case and analytical checklist for student assessment for each PBL case. The checklist categories for interactions between students and standardized patients included gathering information, options/management, and monitoring/follow-up. Checklist categories for interactions between students and the standardized physician

included information gathering, problem statement, options/management, monitoring/follow-up, and closure. These categories addressed knowledge and clinical skills objectives.

Following OSCE case and checklist development, all faculty investigators met to review and agree on final language. The revised cases and checklists were sent to 3 judges (2 content experts and 1 community pharmacist) for external review. They evaluated each item on the checklist for accuracy, clarity, completeness, and standard setting.²⁸ The external judges also determined whether the case was valid, relevant, and realistic for a third-year pharmacy student. These judges began the process of creating the point value for each checklist item using the Angoff method to set the standard score.²⁹⁻³⁰ A minimally competent third-year student in the program should be able to perform with a passing score of 70% on the pharmacy examinations. Faculty investigators compiled the judges' point values and created a final-consensus point value for each item on the checklist, translating consensus percentages to a point scale of 0.1 to 1.0. A global assessment score was included to address the communication and social skills objectives. This score assessed verbal and nonverbal expression; response to patients' feelings and needs; degree of focus, logic, and coherence; and overall presentation. These items were scored on a 1-to-5 Likert scale, with 5 being the highest performance level.

The 40-item multiple-choice examination was developed to additionally assess PBL. The OSCE/PBL case writers were responsible for preparing 10 questions that corresponded to their PBL cases. No overlap existed between the multiple-choice questions and the OSCE. All questions were developed from the stated learning objectives for the PBL case, and questions could be related to the new or reviewed disease states in the PBL case. Questions covered pathophysiology, therapeutics, and patient education, and some were case-based.²⁶ All questions were reviewed by the course coordinator.

For each case, there were 2 OSCE stations, each with an observer and a standardized patient/physician. The observers were faculty members from the pharmacy practice department. The patients in the OSCE stations were portrayed by actors trained as standardized patients for WSU's medical school OSCEs. The physician roles were portrayed by recent medical-school graduates accustomed to OSCE evaluations. Each faculty observer and standardized patient/physician pair were assigned to 1 OSCE station for the entire day to limit interrater variability. The OSCEs were held in the small study rooms of the college's learning resource center.

Standardized patients and observers for a specific OSCE received the case 1 week in advance and met with

a faculty investigator on the morning of the examination to review their case and testing format. Standardized patients were also given scripts that allowed prompting when students veered from the task. No changes to the script were allowed to be made during the examination period by either standardized patients or faculty members. Observers were not given the specific point values for the checklist items.

Half of the 60 third-year pharmacy students completed the OSCE in the morning while the other half completed the PBL multiple-choice examination; the groups switched to the alternate testing procedure in the afternoon. The 2 groups were segregated from each other to retain the validity of the examinations. Students were given 6 minutes to review a stem detailing the OSCE case. Six minutes were allotted for students to complete each OSCE station, with an additional 2 minutes allowed for travel time between stations. All OSCE stations were videotaped to capture examples for training and for student appeal. Resources (eg, digital data systems) were not available for the viewing of videos for assessment purposes.

OSCE and Written-Examination Grading

The course grade for module 8 was divided into 40% for the PBL component and 30% for each of the 2 examinations assessing the didactic component. The OSCE assessment was worth 28% of the overall PBL grade (7% per each case), which equated to 11.2% of the final course grade. For each OSCE case, 75% of the OSCE score came from the analytical checklist and 25% from the global assessment. Videotapes were not reviewed to complete missing data. For any item missing on the global assessment, the denominator for that student's global assessment score was lowered by 5 points. The multiple-choice examination accounted for 72% of the PBL assessment. Observers and standardized patients/physicians did not give any feedback to the students during the OSCE, but students could request individual case scores after receiving their overall OSCE score.

Surveys

Surveys were conducted to gather qualitative data on the effectiveness of OSCEs as perceived by faculty and student participants and to capture suggestions for improvements. The survey instruments were developed after reviewing the findings from published OSCE survey research evaluating the opinions of faculty members and students from other disciplines.^{31,32} The 20-question student survey tool was structured to assess opinions regarding the OSCE case content, use for student assessment, and logistics. The 18-question observer survey tool had similar content categories with the addition of faculty

involvement in the OSCE process. Some questions were similar on both survey tools. Participation of student and faculty observers in the survey was voluntary. Students completed the survey tool after completing their 4 OSCE stations. Faculty members completed the observer survey tool after observing all student performances. The survey tools and study procedures were approved by the WSU Institutional Review Board in Detroit, Michigan.

Data Analysis

Descriptive statistics were used to summarize group OSCE performance and student and faculty survey results. Group performance for each category of each case per observer was calculated. The number of students correctly performing each item in a category was multiplied by that item's specific point value. The values for all items in a given category were then summed and divided by the maximum achievable points if all students had successfully completed all items in that category. A paired Student *t* test was used to compare student scores on overall and specific OSCE cases to the overall and specific PBL-case multiple-choice examination questions, respectively. Correlations were calculated for the relationship between OSCE and PBL multiple-choice performance overall and per specific case. Student performance in terms of analytical checklist, global assessment, and final OSCE case percentage score was compared between faculty observers using an independent Student *t* test. A *p* value of ≤ 0.05 , 2-tailed, was considered significant.

EVALUATION AND ASSESSMENT

Performance results on the OSCE and the multiple-choice examination are delineated in Figure 1. No relationship ($r = 0.15$, $p = 0.24$) existed between OSCE total percentage scores ($68.8\% \pm 7.4\%$; range 48.6% to 83.9%)

Figure 1. Mean percentage scores for an objective structured clinical examination and multiple-choice examination overall and per topic specific to problem-based learning. Abbreviations: PBL = problem-based learning; OSCE = objective structured clinical examination.

and the written PBL examination percentage scores ($81.4\% \pm 7.1\%$; range 64.7% to 92.3%). To delineate further, knowledge assessed from the PBL multiple-choice examination was segregated into sections that correlated to the matching PBL OSCE case content. A small significant relationship existed for the women's health OSCE and women's health PBL-examination questions ($r = 0.281, p = 0.031$), but not for the other topics (pediatrics, $r = 0.018, p = 0.22$; geriatrics, $r = 0.075, p = 0.894$; and men's health, $r = 0.106, p = 0.43$). All OSCE scores were lower than the correlated multiple-choice scores.

OSCE performance for the overall group checklist categories and individual student's checklist, global assessment, and both combined are defined by observer in Table 1. For the knowledge and clinical-skills objectives, students performed best in the area of gathering information for the pediatric, geriatric, and women's health cases. Students scored higher in the options and management category in the geriatric, women's health, and men's health cases than they did in the monitoring and follow-up category. For communication and social skills, the global assessment category revealed variances between observers in the women's health and men's health cases.

PBL cases required each faculty member to dedicate approximately 40 hours for development and review. Thus, a total of 160 hours of faculty time was spent in preparation. Each OSCE case and checklist required at least 8 hours to develop. Once developed, each case was reviewed by the research team and sent to judges for validity. The research team subsequently addressed all of the recommendations and assigned final points by consensus to the scoring checklist, which required about 5 hours. The OSCE assessment-day development involved approximately 60 hours of faculty time over 5 months. During the OSCE assessment day, there were 8 observers dedicating 6.5 hours each, for a total of 52 hours. Two faculty examination-day coordinators required an additional 12 hours each to prepare and oversee the event. The 8 standardized patients and 2 medical students were employed at \$16.00 per hour including travel time, for an 8-hour day for a total cost of \$1280.00. The total grading process took about 4 minutes per case, for a total of approximately 16 hours. Two additional faculty members and 2 support staff members proctored the multiple-choice examinations and in-between waiting time.

Fifty-four students (90%) and all 8 faculty observers (100%) consented to use of their OSCE survey data. The majority of student pharmacists responded that the OSCE reflected their PBL cases and PBL learning (74% and 85%, respectively) (Table 2). Although the students

Table 1. Pharmacy Students' Overall Group and Individual Performance Scores on an Objective Structured Clinical Examination

	Pediatric Case		Geriatric Case		Women's Health Case		Men's Health Case	
	Observer 1	Observer 2	Observer 1	Observer 2	Observer 1	Observer 2	Observer 1	Observer 2
Specific Analytical Checklist Categories								
Gathering information, %	85.3	70.2	67.5	83.7	91.7	95.2	62.6	57.6
Problem statement, %					84.1	85.1		
Options/management, %	50.6	52.4	71.2	64.0	45.9	71.2	66.8	62.5
Monitoring/follow-up, %	56.2	63.3	26.0	40.0	39.7	56.7	50.0	44.7
Closure, %					73.3	96.7		
Performance Summary Data								
Total analytical checklist points, Mean (SD)	7.3 (2.0)	7.0 (1.3)	5.9 (1.2)	6.0 (1.7)	9.4 (1.4)	10.7 (1.2)*	14.8 (2.6)	13.6 (3.8)
Maximum checklist points	11.5	11.5	9.3	9.3	13.2	13.2	23.7	23.7
Total global assessment points (maximum 25 points), Mean (SD)	16.9 (4.4)	17.7 (3.4)	21.4 (2.9)	21.4 (3.6)	20.8 (2.4)	15.3 (3.3) ^b	21.4 (4.0)	14.2 (1.7) ^b
Final OSCE case score ^a , % Mean (SD)	64.6 (16.1)	63.1 (0.8)	69.2 (10.5)	69.5 (15.4)	74.1 (10.0)	79.1 (9.3)	68.2 (10.1)	57.3 (13.5) ^b
Range, %	23.0 - 91.5	40.0 - 83.9	46.6 - 83.7	39.8 - 91.9	53.9 - 94.3	59.2 - 93.2	45.6 - 82.9	34.7 - 82.9

Abbreviations: OSCE = objective structured clinical examination.

^a Final OSCE case score = (total analytical checklist points/maximum analytical checklist points for that case x 100*) x 0.75* + global assessment points ^b $p \leq 0.05$ for difference between case observers for individual student pharmacist data.

Table 2. Student Pharmacists' Responses to a Survey Regarding the Use of an Objective Structured Clinical Examination to Assess Problem-Based Learning (n = 54)

Questions	Agree ^a , No. (%)	Neutral, No. (%)	Disagree ^a , No. (%)
Case Content			
The OSCE cases developed reflected material learned through PBL.	46 (85)	7 (13)	1 (2)
The OSCE reflected important aspects of your PBL case.	40 (74)	11 (20)	3 (6)
Prior to the OSCE, I felt fully aware of the nature of the examination and level of clinical skills needed.	16 (30)	18 (33)	20 (37)
The stem (case scenario) given to you at the beginning of the examination was sufficient for required task.	47 (87)	5 (9)	2 (4)
Difficulty of this OSCE is similar to that of patient-care laboratory practical examinations. ^b	25 (48)	14 (27)	13 (25)
Assessment			
The OSCE measured application of clinical skills and abilities required in pharmacy practice. ^b	41 (80)	8 (16)	2 (4)
The OSCE evaluated your communication skills. ^b	43 (83)	4 (8)	5 (9)
The OSCE evaluated your knowledge. ^b	40 (77)	9 (17)	3 (6)
Performance on this examination was an accurate reflection of my clinical skills.	23 (44)	11 (21)	18 (35)
Which examination style would best test your clinical skills? ^b			
OSCE	26 (51)	-	-
Multiple choice	6 (12)	-	-
Short answer	16 (31)	-	-
Essay	3 (6)	-	-
Which examination style would best test your knowledge? ^b			
OSCE	4 (8)	-	-
Multiple choice	19 (38)	-	-
Short answer	22 (44)	-	-
Essay	5 (10)	-	-
The OSCE allowed me to feel more like a pharmacist than a student. ^b	25 (48)	10 (19)	17 (33)
Logistics			
Adequate directions were given prior to the OSCE. ^b	30 (57)	14 (26)	9 (17)
The scenario of your interaction with the standardized patient/physician was realistic. ^b	41 (77)	7 (13)	5 (10)
Adequate time during the examination was given to prepare for each OSCE station.	50 (93)	3 (5)	1 (2)
Adequate time was allotted at each OSCE station to allow time to complete required tasks.	47 (87)	4 (7)	3 (6)
The OSCE being worth 28% of your final PBL grade was appropriate.	31 (58)	12 (22)	11 (20)
The OSCE was more stressful than written examinations. ^b	28 (54)	12 (23)	12 (23)
The OSCE was more stressful than patient-care laboratory practical examinations. ^b	25 (48)	14 (27)	13 (25)
Selection of observers affected the level of stress during the OSCE. ^b	34 (65)	14 (27)	4 (8)

Abbreviations: OSCE = objective structured clinical examination; PBL = problem-based learning.

^a 5-point Likert scale: agree = strongly agree + agree, disagree = strongly disagree + disagree.

^b Not all students responded to this question, resulting in the total number of responses being less than 54.

reported that the OSCEs evaluated their clinical skills and abilities required for pharmacy practice (80%), the class was split between OSCEs (51%) and short answers (31%) as the best method to assess clinical skills. Short-answer questions (44%) were reported to be the best assessment tool over multiple-choice test questions (38%) and OSCEs (8%) to evaluate their knowledge. Students indicated that the interactions within the cases were realistic (77%) and

that adequate time was allowed to prepare for the stations (93%) and complete all tasks (87%). Only 57% of the students felt that there was sufficient preparation information for the OSCE assessments used in the pharmacotherapy third-year course. They also indicated that these OSCEs were more stressful than those used in patient-care laboratory during years 1 and 2 of the curriculum (48%) and were more stressful than written examinations (54%).

Faculty members reported that the OSCEs were realistic (100%) and at an appropriate level for a third-year pharmacy student (100%), were good assessment tools (88%), and should be required for assessing PBL (88%) (Table 3). However, only 63% of faculty members felt that OSCEs are an effective way to assess PBL competencies. Faculty observers stated that the observer role could be delegated to pharmacy residents (88%). The workload (2.5 hours in the morning and 2 hours in the afternoon of observing the same case) was rated as acceptable. Although most faculty members (75%) indicated that video recording of student performance was necessary, no student requested video review of any case scenario.

Responses were similar between students and faculty members for comparable questions on both survey tools except for realism of the scenarios (77% vs 100%, respectively) and relationship to PBL case (85% vs 63%, respectively). Most students (65%) indicated that observer

selection influenced their testing stress, whereas most faculty observers (87%) responded that a specific observer did not influence student OSCE performance.

DISCUSSION

Performance on the OSCE did not correlate well with the multiple-choice examination for assessment of PBL. The OSCEs evaluated different competencies not measured with written examinations.¹¹ The OSCE assesses problem solving, clinical skills, communication, and social skills, as well as knowledge, while the written examination predominantly tests knowledge and problem solving. OSCEs also present an increased level of stress inherent in any type of oral presentation. Students performed better on the multiple-choice examination, which is a traditional and more familiar form of assessment in most undergraduate courses. As an advantage, multiple-choice quizzes for 3 of the PBL cases provided feedback to students on knowledge of disease states and DRPs

Table 3. Faculty Observer Responses to a Survey Regarding the Use of an Objective Structured Clinical Examination to Assess Problem-Based Learning (n = 8)

Questions	Agree, No. (%) ^a	Neutral, No. (%)	Disagree, No. (%) ^a
Case Content			
Drug related problems presented in the cases were appropriate for third-year pharmacy students.	8 (100)	0	0
Checklists developed represented appropriate expectations for third-year pharmacy students.	6 (75)	2 (25)	0
One OSCE per PBL case is an adequate number.	7 (88)	0	1 (12)
Testing Questions			
The OSCE evaluated students' communication skills.	7 (88)	1 (12)	0
The OSCE allowed students to display knowledge on drug-related problems.	7 (88)	1 (12)	0
The OSCE measured students' application of clinical skills and abilities required in pharmacy practice.	7 (88)	0	1 (12)
The OSCE tested third-year pharmacy students' problem solving skills.	6 (75)	2 (25)	0
Using an OSCE is an effective way to test PBL competencies.	5 (63)	3 (37)	0
An OSCE should be part of PBL standardized testing.	7 (88)	1 (12)	0
Logistics Questions			
Student had adequate time allotted at each station to complete required tasks.	6 (75)	2 (25)	0
Prompts given by actors during the OSCE allowed students to compensate for missed tasks.	5 (63)	2 (25)	1 (12)
Students' stress level impacted their performance on OSCE.	6 (75)	2 (25)	0
Students seemed intimidated by observers.	1 (12)	0	7 (88)
Having a video recorder present is necessary in an instance that a checklist item was missed.	6 (75)	1 (12)	1 (12)
The scenario at each station felt realistic with use of an actor.	8 (100)	0	0
As an observer, I felt I could stay focused while observing the same case repeatedly.	8 (100)	0	0
It would be better to do a different case in the morning and afternoon session.	1 (12)	2 (25)	5 (63)
Pharmacy residents could be used as observers.	7 (88)	1 (12)	0

^a Scores based on a 5-point Likert scale: Agree = strongly agree + agree; Disagree = strongly disagree + disagree; Abbreviations: OSCE = objective structured clinical examination; PBL = problem-based learning.

similar to those found on the final multiple-choice examination.

To further substantiate findings, results from the OSCEs demonstrate variables that affected student performance. As noted by observers, even with standardized patient prompting, some of the students failed to identify the DRPs, which drastically influenced their OSCE scores. As predicted, students performed best on knowledge skills because of the development of these skills in first- and second-year patient-care laboratory OSCEs. Other factors potentially contributing to students' lower OSCE performance include the limited exposure of third-year students to patient-care activities and minimal opportunities to enhance their problem-solving skills and communication with physicians. Not all students have community or inpatient pharmacy internship positions, resulting in less experience communicating in OSCE-like clinical scenarios. For some, the presence of a faculty observer induced stress during the OSCEs, which would be less likely to occur during a written examination. These data suggest that performance-based examinations used along with knowledge-based examinations provide a more comprehensive assessment of student learning at higher-thinking levels. Along with literature supporting the reliability of adding a written test to an OSCE for assessment, our results further demonstrate the need for incorporating a variety of assessments in pharmacy.^{11,13,33} Although OSCEs have not been used to assess learning from the PBL experience in pharmacy, a few studies have compared the performance on multiple-choice examination to that of OSCE in a traditional therapeutics course³⁴ and yearly summative evaluations.¹¹ Using the Angoff method for standard setting in scoring of OSCEs, which is similar to our point setting, Gardner and colleagues reported a moderately positive correlation ($r = 0.59, p < 0.001$) between performances on the 2 examinations.³⁴ Similarly, Kriton and colleagues found a moderate correlation ($r = 0.6, p < 0.0001$) for assessment of a third-year culminating OSCE and multiple-choice examination.¹¹ Our results did not show a correlation ($r = 0.15, p = 0.24$) between the students' performances on the OSCE and the multiple-choice examination. Comparisons with the other studies are not definitive. The examination processes of OSCE and multiple-choice deliveries were not comparable.

When analyzing the OSCE results, variations in average scores between cases and observers were found for a few areas, but overall, the results were more similar than expected. The scores for the men's health case were lower because of students' confusion regarding standard Indian Health Service counseling questions. Potentially, lower global assessment scores for the pediatric case were attributable to student discomfort with discussing sex

education with a patient, especially because the adolescent male patient was instructed to act disinterested. Surprisingly, the students performed best with the women's health case requiring communication with a physician, which is the least-developed communication skill in the curriculum. The women's health case DRP might also have been easier to identify and solve than the other case DRPs. The higher scores might also relate to an OSCE case heavily focused on knowledge and evidence. The global assessment is inherently subjective and results are influenced by faculty expectations of the students. For the women's and men's health cases, there were significant differences among observers. The challenge with any subjective student assessment is to clearly communicate to the evaluator that scores should not be representative of practicing pharmacists but rather of students with minimally mentored experiential training. Training with a rubric prior to assessment day most likely would improve observer interrater reliability.

The process of using an OSCE for evaluation of knowledge and clinical skills related to PBL was valued by both students (77% and 80%, respectively) and faculty observers (88% and 88%, respectively). Generally, student and faculty opinions about the OSCE were similar for realism of the student/standardized patient interaction (77% and 100%, respectively) and OSCE cases reflecting material learned though PBL (85% and 63%, respectively). Perceptions differed on the influence and bias of selected observers on student performance (65% and 12%, respectively). The realism of the scenarios might have been difficult for students to assess because of their minimal practice experience (study was conducted before 300 introductory pharmacy-practice experience hours were incorporated into the curriculum). Similarly, because the faculty observers were not the PBL facilitators, they were unable to assess the relationship between the OSCE and PBL cases. Students expressed that OSCEs from patient-care laboratory courses in the first and second years of the curriculum were less stressful than the OSCE designed to test PBL in the pharmacotherapy module 8 (48%). The patient-care laboratory courses use both formative and summative OSCEs, increasing familiarity with the process and decreasing stress. No formative OSCEs were used in module 8, potentially increasing stress. Although the patient-care laboratory OSCEs assess similar clinical and communication skills, the degree of complexity of the cases is lower.

Pre-OSCE training of students was a limitation of the first offering of OSCEs in this course, as evidenced by students expressing that they felt unprepared for this type of examination. This result is consistent with that of similar surveys reported in the literature.^{20,35} This OSCE

used a process and procedure similar to that of the patient-care laboratory OSCEs, potentially influencing student expectations. The training for our OSCE was limited to 1 hour and based mostly on logistics. In subsequent years, previous module-8 OSCE student videos and the respective checklists were reviewed with the students using the checklists to evaluate student performance on 2 training OSCE videos.

Compared with the results of similar surveys reported for pharmacy students' perceptions of logistics for OSCEs, our results are consistent with respect to adequate directions and realism of OSCE scenarios.³⁵ Conversely, more of these students agreed that adequate time was allotted for the OSCE stations^{20,35,36} and that the OSCE was more stressful than other types of examinations, while fewer agreed that they were fully aware of the nature of the examination.^{20,35}

Incorporating OSCEs into the assessment of PBL has several limitations, including commitment of faculty time and considerable cost. In fact, only 63% of faculty observers believed that OSCE is an effective way to assess overall learning but it appears most relevant to PBL testing (88%). In this study, limited time was allotted for the training of students, standardized patients, and faculty members. More intense training may not only increase students' comfort with the examination process but also improve performance and limit variations in assessments by the observers and even the standardized patients.

CONCLUSION

With the growing incorporation of active-learning techniques such as PBL in the pharmacy curriculum, appropriate assessment tools are required. A 4-station OSCE was added to a 40-item multiple-choice examination to assess student learning from the PBL experience. The comparison of student performance using these examination tools suggests that incorporating multiple-assessment strategies may provide a more comprehensive as well as a higher-order-of-thinking method for the assessment of student learning from the PBL experience. Faculty members and students both indicate that the OSCE evaluated learning objectives for the PBL cases and should be part of the evaluation of competencies for PBL.

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