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Original article

Integrating simulation into advanced pharmacy practice experience curriculum: An innovative approach to training

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ABSTRACT

Background: The use of simulation-based education (SBE) in pharmacy education can help students acquire the essential clinical knowledge and skills for practice and can enhance patients' safety. Simulation-based training has been implemented in inter-professional education training, introductory pharmacy practice experiences, pharmacy residency training. Still, there is limited information in the literature that assesses the use of simulation in advanced pharmacy practice experience (APPE).
Objective: To evaluate the impact of integrating SBE into APPE on students' learning outcomes, training costs, and satisfaction.
Method: This study presents a new training model of a 5-week clerkship experience where sixth-year pharmacy students alternate between hospital wards and simulation rooms. Student assessment rubrics were used to measure students' achievements and report faculty feedback. Students filled scenario evaluation forms to assess their simulation satisfaction rate.
Results: A total of 57 students completed a full block of simulation-based, followed by hospital-based blocks practicing in the same medical specialty in both blocks. This newly structured experience provided fourteen direct patient care training seats per rotation and saved around 25,000 Saudi Riyals per rotation. The mean grades in both simulation and hospital-based blocks were mostly above 90% in all learning outcomes. Cognitive skills and affect learning outcomes mean grades were higher in the simulation-based group—most of the students being satisfied with the simulation scenarios.
Conclusion: SBE integration into APPE can supplement hospital-based experiential training to achieve the best learning outcomes with improved students' satisfaction.

1. Introduction

Simulation-based education (SBE) widely embraced in various health disciplines (Beal et al., 2017; Kincaid et al., 2003; Powell-Laney, 2012; Seybert et al., 2008). There are many forms of simulation that can be utilized in health care education ranging from simple to highly complex simulators (Durham and Alden, 2008). Types of simulation used include human patient simulators ; (high, moderate or low-fidelity patient simulator or mannequin), part-task trainers, standardized patients, virtual reality simulation, screen-based computer simulators and integrated simulators (Lin et al., 2011; Durham and Alden., 2008).

The incorporation of SBE in pharmacy education has evolved, and its impact has been widely studied (Ong et al., 2018; Seybert et al., 2006, 2012, 2019). The use of simulation in advanced pharmacy training improves learner's knowledge, clinical skills, and confidence (Fernandez et al., 2007; Seybert et al., 2007, 2008; Atayee et al., 2016). SBE has also been used in interprofessional education (IPE) to facilitate team-based learning (Zhang et al., 2011; Kayyali et al., 2019). It enhances inter-professional communication and team performance (Maxwell et al. 2016). Therefore, the use of simulation in team-based training is encouraged in pharmacy education. (Kane-Gill et al. 2011). The United States (U.S) Accreditation Council for Pharmacy Education (ACPE) accreditation standards for PharmD programs recommends the use of SBE in interprofessional team education and introductory pharmacy practice experiences (IPPE) to mimic realistic patient care situations (Accreditation Council for Pharmacy Education, 2015). Many pharmacy schools adopted SBE effectively in their curriculum in skills practice laboratories, pharmacotherapy courses, and IPPE (Lin

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et al. 2011; Seybret et al. 2008; Seybert et al., 2019). For example, Seybert et al. presented an experience of applying a simulation teaching model (Seybert et al., 2019). In that model, they incorporated simulation education into pharmacy training programs and found that high-fidelity simulation improved the assessment and the development of students' patient-centered care skills. (Seybert et al., 2007, 2008).

Pharmacy programs inside and outside the U.S aim to meet the ACPE standards and incorporate simulation in pharmacy curricula. However, it is sometimes challenging to identify where SBE best fits in the curriculum and how to use it. The ACPE recommendation about SBE use in concerning the Pre- advanced pharmacy practice experience (APPE), but did not state any explicit suggestion about the use of SBE in APPE. Yet, the ACPE requires designing field practice experiences that enable the students to apply knowledge and skills learned in the Doctor of Pharmacy (PharmD) curriculum in actual practice settings (Accreditation Council for Pharmacy Education, 2015). According to ACPE standard 13.6, students should receive at least four field experiences where they can practice providing direct patient care. In the following practice settings: a community pharmacy, an ambulatory patient care environment, a hospital or health system pharmacy, and inpatient general medicine patient care (Accreditation Council for Pharmacy Education, 2015).

In Saudi Arabia, it has been challenging to provide all students with field training experiences that meet these ACPE requirements and achieve the program learning outcomes, especially experiences that provide direct clinical care. Aljadhey et al. (2017) highlighted some issues with pharmacy experiential training in Saudi Arabia, including limited available training seats and different quality of training sites (Aljadhey et al. 2017). In the last few years in Saudi Arabia, it became more problematic to find training sites that offer direct patient care and can accommodate all pharmacy students during their internship year. The clinical experience training seats offered from external sites to our students covered around 36% of our students per rotation in 2017. In 2018, 37% of our interns per rotation and even decreased to 14% in 2019. Aljadhey et al. suggested that the use of simulation in training to minimize the impact of these issues (Aljadhey et al., 2017). Simulation-based (SB) training has been applied in IPE, Pharmacotherapy courses, introductory pharmacy practice experience (IPPE), and pharmacy residency training (Kayyali et al., 2019; Lin et al., 2011; Morris et al., 2019; Seybert et al., 2012), but there is limited information in the literature that assesses the use of simulation in APPE. This study aims to use to evaluate the impact of integrating SBE into APPE on students' learning outcomes, training costs, and satisfaction

2. Material and methods

This study presents of a new training approach implemented at the College of Pharmacy (COP), Princess Noura bint Abdulrahman University (PNU), in Riyadh, Saudi Arabia.

2.1. Context of the training

COP graduates around 100 students annually earning PharmD degree, except for the year 2019, were the graduate number increased to 240 students. After high school, students need to complete a foundation year of the health colleges (year one) at PNU before they join the PharmD program, where they spend another 5 years to complete a total of 6 years. In the middle of the fourth year, students start their first introductory field experiential training (IPPE-1). A second experiential training (IPPE-2) is also provided at the end of the fourth year. During the fifth year, students get their third experiential training (IPPE-3). Each of those IPPE training has its training focus and area of practice. Students start their APPE "internship year" in their last year (sixth year). During that year, students rotate between nine different pharmacy practice sites; each rotation duration is five weeks. The core rotations focus on direct patient practice settings spent usually in King Abdullah Bin Abdulaziz University Hospital (KAAUH) hospital wards or other collaborating hospitals.

PNU is well known for its unique educational programs and facilities consisting of the 16 colleges, KAAUH, health sciences research centers, and Simulation and Skills Development Center (SSDC). In 2017, KAAUH was officially inaugurated. It is a secondary teaching hospital that includes 300-beds serving PNU faculty, students, and community. In PNU campus one of the biggest simulation centers in the world, "SSDC," was established in 2015. The center is accredited from the Society for Simulation in Healthcare in the U.S.A. It provides the latest technologies available for medical simulation, more than 200 simulators, and virtual reality devices. All these technologies are used to supports medical education and the clinical training of the health colleges' students and health care practitioners. It also has medical rooms that simulates the hospitals' operating rooms, intensive care unit, and emergency rooms; each of them is equipped with the recent technologies that permit trainers to track trainees and control training content. COP at PNU usually collaborates with SSCD and KAAUH to provide pharmacy and interprofessional training.

2.2. Design of the training

The simulation integrated rotation scheduled during the internship year. It was structured as a 5-week clerkship experience. Students alternate between hospital clinical wards and simulation theaters under the same specialty. Within each 5-week rotation, each student spent two to five days in the simulation rooms "simulation-based (SB) block," applying simulation-based scenarios. This block was followed by another two to five days spent in the hospital ward of the same specialty, "hospital-based (HB) block." Both hospital wards and simulation rooms were running at the same time to accommodate the largest number of students at once. Considering the SSCD simulation rooms and the active wards of KAAUH, the medical specialties offered during this training were internal medicine (IM), surgery, and pediatrics. Before the training starts, faculty received simulation utilization training and effective scenario writing training to design SB scenarios tailored to pharmacy students. The contribution of faculty members writing the scenarios enriched the bank of scenarios at SSDC.

The SB-APPE training was an acute patient care experience that exposes students to a clinical, team-based environment under various medical specialties either at the hospital wards or the simulation rooms. The integration of SBE into the APPE curriculum intended to achieve the desired training learning outcomes. Those outcomes are aligned with the program learning outcomes and the learning outcomes articulated by ACPE Standards 1–4 (Accreditation Council for Pharmacy Education, 2015). Those learning outcomes encompass the Center of Advancement of Pharmacy Education (CAPE) as part of the American Association of the Colleges of Pharmacy (AACP; Medina et al., 2013), the National Center for Academic Accreditation and Assessment (NCAAA), and the college's stated program learning outcomes. Most learning outcomes were already included in the field experience course specifications, as provided in the NCAAA forms Table 1. This SB experience focused on the following three domains: cognitive, affective (responsibility and communication, information technology, numerical), and interpersonal skills. The desired learning outcomes for these domains are listed in Table 1.

Table 1
The Course Learning Outcomes from the NCAAA Course Specification Form Aligned with the Students Assessment Rubric Items.

Course Learning Outcomes in National Quality Framework Domains of Learning and Alignment with the Training Strategy			
Domain Code #	NQF Learning Domains and Course Learning Outcomes	Training Strategies	Example of items assessed in students' rubrics
1.0	**Knowledge**		
1.1	Describe the etiology, pathophysiology, clinical presentation, and prevention of common diseases occurring in acute care patients.	• Interdisciplinary team rounds anddiscussions • Guideline review • Medical literature searches	Describes the expected mechanism of action, therapeutic response, adverse effects, dose, dosage form, and monitoring parameters for a given drug or combination of drugs.
1.2	Identify drug-related problems; explore and prioritize potential strategies.	• Interdisciplinary team rounds and discussions • Guideline review • Medical literature searches	Prioritizes drug-related problems
1.3	Demonstrate appropriate depth and breadth of pharmacotherapeutics and disease-related knowledge for common conditions in adult or pediatric, inpatient, general medicine patients.	• Interdisciplinary team rounds • Patient cases/scenarios	Demonstrates knowledge of disease states appropriate for this clinical setting
2.0	**Cognitive Skills**		
2.1	Design and implement patient-specific, evidence-based patient care plan, and follow up to determine patient progress and evaluate the viable solution.	• Interdisciplinary team rounds and discussions • Guideline review • Medical literature searches	• Responds to the offered cues to guide the simulation process into the right direction • Monitors patient progress closely and able to adjust treatment as indicated by patient response • Creates and documents a therapeutic drug monitoring plan and interventions to achieve optimal outcomes • Performs a daily follow-up to check the progress of the patient
2.2	Demonstrate clinical care that incorporates the principles and application of evidence-based practice and Information Mastery.	• Interdisciplinary team rounds • Patient Cases/scenarios Discussion	• Actively seeks information to plan appropriate intervention • Uses appropriate drug information resources to develop responses to drug information requests • Demonstrates the ability to synthesize and integrate information (clinical, cultural, ethical, economic and legal) effectively when making practice- and/or patient care related decisions
2.3	Assess collected information, develop individualized patient care plans, and evaluate care plans to determine necessary adjustments.	• Interdisciplinary team rounds • Patient cases/scenarios • Problem solving	• Performs accurate patient assessment Able to choose alternative medication based on hospital formulary, dosage form, shortage, etc. • Obtains and assesses all relevant background information needed to clarify the question or information need • Effectively collects useful data from medical chart, and observes the simulator and interacts with the patient/caregiver or healthcare professionals
3.0	**Interpersonal Skills & Responsibility**		
3.1	Demonstrate the ability to engage in self-assessment and self-directed learning to improve personal and professional abilities on an ongoing basis.	• Interdisciplinary team rounds • Patient Cases/scenarios Discussion	• Independently evaluates and analyzes personal clinical performance during simulation, noticing decision points and evaluating alternatives • Demonstrates the ability to accept constructive feedback and a willingness to correct and learn from errors
3.2	Identify the roles and responsibilities of healthcare team members and educate team members on pharmacy topics relevant to their roles and practice.	• Interdisciplinary team rounds • Patient Cases/scenarios Discussion	• Delegates team assignments and gives a clear role for each pharmacy intern • Takes responsibility as a member of the healthcare team to achieve shared goals
3.3	Actively participate and engage as a healthcare team member by demonstrating mutual respect, understanding, and values to meet patient care needs. Use interpersonal skills to build trusting relationships.	• Attending rounds • Patient cases/scenarios • Patient communication (interview, counseling, reconciliation, and education) • Communication with other health care professionals	• Communicates appropriately with preceptor, healthcare provider, colleague, etc. • Develops positive professional relationships with other healthcare providers
4.0	**Communication, Information Technology, Numerical "Affect"**		
4.1	Effectively communicate verbally and nonverbally when interacting with an individual, group, or organization using a structured approach.	• Attending rounds • Discussions • Patient/healthcare teamCommunication • Notes	• Communicates effectively verbally and nonverbally in a manner appropriate for the intended audience (e.g. patient, healthcare provider, colleague, etc.) • Provides effective patient counseling and education to optimize health and therapy outcomes • Speaks clearly and uses correct verbal and nonverbal language
4.2	Document patient care activities clearly, concisely, and accurately using appropriate technology.	• Notes • Educational material	• Responds to questions in a clear and concise manner with supporting evidence/rationale.

(*continued on next page*)

Table 1 (*continued*)

Course Learning Outcomes in National Quality Framework Domains of Learning and Alignment with the Training Strategy			
Domain Code #	NQF Learning Domains and Course Learning Outcomes	Training Strategies	Example of items assessed in students' rubrics
4.3	Exhibit behaviors and values that are consistent with the trust given to the profession by patients, other healthcare providers, and society.	• Attendance • Rounds • Discussions	• Demonstrates commitment to ongoing improvement • Complies with all applicable Ministry of Health and hospital policies and laws and maintains patient confidentiality
4.4	Demonstrate professionalism as it relates to appearance, timeliness, initiative, responsibility, judgment, and insight.	• Attendance • Rounds • Attire	• Maintains a high standard for personal and professional demeanor, accepting responsibility and accountability for words and actions • Manages time well, arriving on time to begin required activities promptly and completes tasks in the required time frame • Takes responsibility for creating and achieving the goals that are appropriate for the assigned activity

This study was exempt from needing PNU Institutional Review Board (IRB) approval, as it was conducted in an educational setting and used existing data from educational assessment tools that were part of the curriculum. Students and faculty members who completed those assessment forms could not be identified. IRB exemption number 20–0035

2.3. Implementation of the training

A total of fifty seven students were observed between January to April 2019. However, this training model continued even after the observation window. During this observation period, we looked at three provided simulation integrated rotation. Each integrated simulation accommodated around fourteen students per rotation. Those fourteen students were then divided into two groups of about seven students starting the rotation at the hospital wards and simultaneously the other group starting at the simulation rooms. The first batch of the students who took the simulation integrated rotation alternated between the hospital and simulation rooms, each week was focusing on the following specialties: IM and surgery. Each block of specialization may be repeated more than once. The second batch block specialties were in IM and pediatrics while the third batch was in surgery and IM. This variation in each rotation was due to the availability of simulation rooms at the center and faculty members.

Weeks before the start of the SB blocks, faculty members arranged with the support of the SSDC staff and the pharmacy practice department at COP the needed personal, simulators, and facilities. Depending on the scenario implemented, the essentials for simulation include the utilization of human patient simulators, such as task trainers, high-fidelity mannequins (e.g., SimMan). Also, scheduled simulation theaters, debriefing rooms, a trainer specialized in SBE, standardized patients, and any extra person needed to simulate patients' caregivers or healthcare providers. Few days before the scenario, faculty members perform a dry run of the scenario utilizing the available scenarios in the SSDC bank of scenarios. The day in the SB block started with a pre-simulation briefing. In this step, faculty members gave a brief narrative description of one or more patient scenarios daily. The students were then given between thirty and sixty min to read and prepare for the scenario before entering the simulation theater in groups of two to three students. The faculty member at that time were in the control room, offering cues to stimulate the students throughout the simulation algorithm. Other faculty members or trained students may assist in impersonating family members or a member of the health care team. Post-simulation, the faculty debrief the students allowing both the faculty and the students to reexamine the simulated case and reflect on that experience to gain a clear understanding of their actions and thought process. The scenarios were followed by relevant topic discussions or journal clubs related to the case. The other HB block group of students was practicing under the supervision of a faculty member to provide direct patient-centered care in the same specialty area scheduled simultaneously at the simulation center.

2.4. Students assessment

After each block, faculty members supervising the students during the SB block, and HB block filled the evaluation forms. This assessment included providing formative feedback, related to specific performance criteria, to students throughout the APPE experience, in addition to summative evaluation rubrics. The evaluation rubric used for HB blocks were already used for other HB rotation at the college. However, a modified rubric created to match the desired learning outcomes as any HB rotation. The SB rubric rather focused on cognitive, affective, and interpersonal skills, but did not incorporate knowledge assessment as the hospital-based block evaluation rubric. The assessment rubrics included several items, each aligned with one of the learning outcomes listed in Table 1. Each outcome was evaluated on a scale from one to five, where 1 = Unsatisfactory, 2 = Marginal, 3 = Good, 4 = Very good, and 5 = Exceptional. Evaluation forms are available in Appendix-1. To assess each students' achievement, the mean grade for items aligned with each domain calculated out of 100. The mean grades of each domain in the SB blocks was compared to the complementing HB block covering the same specialty (IM, ED, pediatrics).

2.5. Evaluation of the training

Faculty members' feedback and suggestions for improvement were collected in the in the comment section of the students' evaluation forms. Students' satisfaction rate about the simulation scenarios was gathered through another evaluation rubrics that were filled at the end of each scenario. These rubrics included several items to measure their satisfaction as presented in Table 3. The total mean score of each scenario was calculated to get the mean satisfaction rate out of 100% for all students.

2.6. Statistical analysis

The mean of the students' grades in all learning outcome domains and satisfaction items were calculated and presented as mean ± standard deviation (SD). Two-way ANOVA was used to compare the difference in SB blocks mean grades and HB blocks. The P values were reported as statistically significant if $P < 0.05$.

Data collected from students 'scenarios assessment rubrics via Research Electronic Data Capture (REDCap 8.9.0 software REDCAP version 7.3.6 Nashville, TN, USA hosted at Princess Nourah bint Abdulrahman University). Analyses were performed using Microsoft Excel Version 16.36 (Redmond, Va) and GraphPad Prism 8.4.2 (Windows).

3. Results

Between January 2019 and April 2019, A total of 57 fifty seven students completed a full block of SB blocks followed by HB blocks practicing in the same specialty either in: surgery, internal medicine, and pediatrics.

3.1. Impact of simulation on the learning outcomes

The knowledge domain was only assessed in the HB evaluation forms. In that domain, students' mean grades were 88,89 and 88 out of 100 in the learning outcomes 1.1,1.2 and 1.3 respectively. Overall, students achieved higher grades in the SB blocks than the HB group with a mean difference of 4.7 ($p < 0.0001$). Yet, in both groups, the mean grades were mostly above 90%. Cognitive skills and affect learning outcomes (except for 4.3) mean grades were statically higher in the simulation-based blocks. Table 2 presents a comparison between students' grades for each learning outcome that were achieved in the HB blocks and SB blocks.

3.2. Evaluation of training

Most of the students reported that they were satisfied (at 80% or above) with the simulation scenarios integration regardless of the case specialty, as shown in Table 3. Additionally, common faculty comments indicated that integrating simulation into the APPE had the following effects on students: "*it improved their confidence and skills pertaining to communication, leadership, and teamwork*". On the other hand, common faculty comments indicated that "*students still needed improvement in the following areas: patient case presentation delivery and utilizing the literature to prepare for the patients or scenarios*".

3.3. Impact on training seats availability and cost

Around fourteen direct patient care APPE seats per rotation were offered through this experience to our students. As parallel sites were operating simultaneously in the hospital and the simulation center, the program offered more clinical seats for the students. The estimated cost of HB training seats in external sites was approximately 1800 Saudi Riyals per student per rotation. Establishing the integrated simulation rotation increased the number of direct patient care training seats from 14% in 2019 to 38%. The remaining students received their direct patient care experiential training in external hospitals collaborating with the University. However, we were able to save around 25,000 Saudi Riyals of the training costs per rotation utilizing PNU own resources including the SSDC, KAAUH and COP faculty members with no cost

4. Discussion

In this experience, incorporating SBE into the APPE supported achieving the intended learning outcomes related to cognition, interpersonal and communication skills. Using simulation in IPPE training has shown to develop students' clinical competencies and improving their critical thinking (Seybert, 2011; Vyas et al., 2012). SBE has been found to be an effective method for enhancing the interpersonal communication skills of health sciences students (Saaranen et al., 2015; Kane-Gill et al., 2011). Similarly, in this study, the student's grades in the interpersonal skills were high but not statistically higher in the HB training group. Pharmacy education is lacking the training in interdisciplinary teamwork which is a vital component in health education for patient safety (Kayyali et al., 2019). Integrating SBE into APPE training may offer a solution to current challenges in students' experiential training. The presented experience emphasizes collaborative teamwork. It also made more clinical training seats available to students, helping to increase the university hospital training capacity by allowing

Table 2
Comparing Students' Mean Grades Achieved in the Hospital-based Blocks and the Simulation-based Blocks.

Learning outcomes number	Learning outcomes	Hospital-based blocks students' grades Mean ± SD	Simulation-based blocks students' grads, Mean ± SD	Mean difference in grades	*p*-value
2	**Cognitive skills**				
2.1	Design and implement patient-specific, evidence-based patient care plan, and follow up to determine patient progress and evaluate the viable solution	99 ± 12.2	97.5 ± 6.1	−6.596	0.0004
2.2	Demonstrate clinical care that incorporates the principles and application of evidence-based practice and Information Mastery	91.1 ± 12.9	96.5 ± 10.1	−5.38	0.0083
2.3	Assess collected information, develop individualized patient care plans, and evaluate care plans to determine necessary adjustments	90.6 ± 11.5	96.3 ± 7.5	−5.705	0.004
3	**Interpersonal Skills & Responsibility**				
3.1	Demonstrate the ability to engage in self-assessment and self-directed learning to improve personal and professional abilities on an ongoing basis	96 ± 7.3	98.4 ± 4.1	−2.456	0.7386
3.2	Identify the roles and responsibilities of healthcare team members and educate team members on pharmacy topics relevant to their roles and practice	95.8 ± 8.2	96.1 ± 8.0	−0.3509	> 0.9999
3.3	Actively participate and engage as a healthcare team member by demonstrating mutual respect, understanding, and values to meet patient care needs. Use interpersonal skills to build trusting relationships.	95.1 ± 9.5	98.8 ± 3.8	−3.684	0.1974
4	**Communication, Information Technology, Numerical "Affect"**				
4.1	Effectively communicate verbally and nonverbally when interacting with an individual, group, or organization using a structured approach	92.6 ± 7.9	97.5 ± 6.6	−4.912	0.0223
4.2	Document patient care activities clearly, concisely, and accurately using appropriate technology	89.1 ± 15.6	97.5 ± 6.6	−8.421	<0.0001
4.3	Exhibit behaviors and values that are consistent with the trust given to the profession by patients, other healthcare providers, and society	95.1 ± 9.5	99 ± 4.5	−3.86	0.151
4.4	Demonstrate professionalism as it relates to appearance, timeliness, initiative, responsibility, judgment, and insight	94 ± 8.0	99.2 ± 2.2	−5.279	0.0103

Table 3
Students' Satisfaction with Simulation Integration in the APPE.

	Simulation Anaphylaxes Case N = 28	Simulation Cirrhosis Case N = 24	Simulation Asthma Case N = 31	Simulation DKA N = 21	Simulation lab Burn N = 22
This simulation case provided is relevant to the practice, mean ± SD	4.7 ± 0.5	4.3 ± 0.6	4.5 ± 0.7	4.1 ± 1.2	4 ± 1.1
The simulation case was realistic enough for me to engage in learning,mean ± SD	4.6 ± 0.5	4.3 ± 0.7	4.6 ± 0.5	4 ± 1.1	4.3 ± 0.9
This simulation case was effective in teaching basic skills, mean ± SD	4.7 ± 0.5	4.1 ± 0.9	4.6 ± 0.6	3.9 ± 1.2	4.3 ± 1
The simulation case helped me improve my teamwork skills, mean ± SD	4.7 ± 0.5	4.3 ± 0.7	4.6 ± 0.6	4.1 ± 1.2	4.1 ± 1.1
This simulation case was effective in teaching medication management skills, mean ± SD	4.6 ± 0.7	4.1 ± 0.9	4.6 ± 0.6	4 ± 1.1	4.2 ± 1.1
The debrief created a safe environment, mean ± SD	4.7 ± 0.5	4.1 ± 1	4.5 ± 0.7	4 ± 1.1	4 ± 1.1
The debrief promoted reflection and team discussion, mean ± SD	4.7 ± 0.5	4.2 ± 0.9	4.5 ± 0.8	3.9 ± 1.3	4.3 ± 0.9
Mean Satisfaction Rate out of 100%	93.5%	84%	90.0%	80%	84%

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = disagree, and 1 = Strongly disagree, DKA: Diabetic Ketoacidosis

faculty members to train our students at the hospital wards and simulation center. Students' satisfaction rate at the end of the simulation scenarios was high, which agrees with previous findings that pharmacy students prefer SBE (Fernandez et al., 2007).

One of the drawbacks of the use of simulation in health education is its high cost (Lin et al., 2011). PNU resources offered to health colleges, including KAAUH and SSDC facilities and services at no cost, saved the college some training cost. However, this did not consider the cost of SSDC resources used, including the simulators, training, and technical support costs. Besides, implanting SBE into the training curriculum was not that simple. The preparation for this rotation took around six months. The faculty needed training on the effective utilization of the resources and the equipment available at the SSDC. Since SSDC is a shared facility by other PNU health colleges, the coordination between COP and SSDC required a lot of effort and time. The college needed to reserve the SSDC's simulation rooms and services for the whole academic year ahead of time. Arranging faculty members' schedules to accommodate the hospital or simulation blocks between their other scholar and teaching duties was also tricky. When the blocks were for a few days, it was tedious and time-consuming to collect almost five evaluating forms for each student to calculate their total grade for the rotation.

In Saudi Arabia, one of the reasons causing the issue of limited training seats was the increasing numbers of pharmacy graduates and pharmacy schools in the last few years. Thus, not all students get equal opportunities to practice a direct patient care rotation compromising their learning experience and, therefore, would affect their career trajectories as well. Many previous studies have suggested using SBE in clinical teaching and training in Saudi Arabia to tackle existing training challenges (Aljadhey et al., 2017; Cheema, 2018). Another exploratory study conducted in Kuwait to assess pharmacists' perceptions about SBE, highlighted the need to implement simulation in pharmacy students' education and training (Katoue and Ker, 2019). Faculty members mentioned that students need to improve their care presenting skills and utilizing literature for the patient scenario. Tackling this defect in training wasn't easy to do when students spend a short duration in each specialty within one rotation. Therefore, the simulation integrated rotation was restructured to place all five weeks clerkships of HB and SB training blocks in IM. This modification gave the faculty the time to focus on improving students' patient care skills and evaluating the students effectively.

Although this study presents a novel solution to achieve the desired learning outcomes of APPE, it is not free of limitations. First, the college had no previous framework to build on this rotation structure. Also, knowledge was only assessed in the HB training making it difficult to assess student's knowledge gain in the SB blocks. Student achievement was measured through assessment rubrics, which may be subjected to human bias. Thus, a pre- and post-rotation student assessment tests may be a better measurement to precisely measure the effectiveness of integrating simulation on students' knowledge and skills.

Additionally, the scenario evaluation rubrics used for students' feedback could lead to response bias, in which participants could have provided favorable responses. However, despite the study's limitations, the benefit of integrating simulation and real-world practice is evident. This training method provides students with structured direct patient care and experiential education in a safe learning environment. It also exposes them to ideal interprofessional team collaboration and allows them to address cases that are rare and may be missed in HB training. We suggest such experience may be applied to other health science colleges students where each participate in their roles to embrace interprofessional collaboration with SBE for patient safety.

In conclusion, this study presents an SBE model that can be used in pharmacy training and other health disciplines training. However, we emphasize that the intended purpose of this study was not to assess whether SB training is more beneficial than HB training. SBE remains a method that cannot replace existing training approaches. Instead, it supplements HB experiential training to enhance students' skills and achieve the best learning outcomes. Also, it increases students' confidence, satisfaction, and may decrease training costs.

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Appendix A. Supplementary data

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