Tropical Journal of Pharmaceutical Research December 2021; 20 (12): 2597-2604
ISSN: 1596-5996 (print); 1596-9827 (electronic)
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Available online at http://www.tjpr.org
http://dx.doi.org/10.4314/tjpr.v20i12.20

Original Research Article

Integrating simulation into Introductory Pharmacy Practice Experience (IPPE): A case study from Saudi Arabia

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Sent for review: 7 April 2021 *Revised accepted: 2 December 2021*

Abstract

Purpose: *To provide a model for using a simulation pharmacy lab as an adjunct to on-site training and assess its effectiveness for the introductory pharmacy practice experiences (IPPEs) community pharmacy setting as part of the PharmD program in Saudi Arabia.*
Methods: *The simulation pharmacy was developed and used as an adjunct to on-site training. The use of the lab in the IPPE community pharmacy course was assessed using online perceptions and self-confidence survey instruments, as well as a standard course evaluation.*
Results: *The self-efficacy assessment indicated that students were "confident" they had gained the practical skills related to the course objectives (weighted mean 3.41 out of 5). They "agreed" with the positive aspects of using the simulation pharmacy lab as an instructional model in this course (weighted mean 3.6 out of 5). However, they felt "neutral" towards the course aspects such as the clarity of the course objectives and the benefits of the didactic in-class lectures (weighted mean 3.2 out of 5).*
Conclusion: *The study results indicate that, although students were confident in their new skills and were satisfied with the simulation lab as a teaching model, they were less satisfied with the course itself. This could be due to the nature of an application-based course, which uses a new teaching strategy that created resistance in the students who had not been routinely exposed to similar courses. This simulation-based course also laid the groundwork for a similar course to be implemented at other colleges and schools of pharmacy. This model will help to overcome the challenges facing IPPEs.*

Keywords: *IPPE, Pharmacy education, Simulation*

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Tropical Journal of Pharmaceutical Research is indexed by Science Citation Index (SciSearch), Scopus, International Pharmaceutical Abstract, Chemical Abstracts, Embase, Index Copernicus, EBSCO, African Index Medicus, JournalSeek, Journal Citation Reports/Science Edition, Directory of Open Access Journals (DOAJ), African Journal Online, Bioline International, Open-J-Gate and Pharmacy Abstracts

INTRODUCTION

Healthcare education has been evolving worldwide [1].The utilization of active learning methodologies has gained great popularity in all health disciplines, including pharmacy [2]. According to the Accreditation Council for Pharmacy Education (ACPE), active learning strategies include the utilization of computer and other instructional technologies, laboratory experiences, case studies, discussions, simulations, and other practice-based exercises [3]. Simulation is defined as "an instructional process that substitutes real patient encounters with artificial models, live actors or virtual reality patients" [4]. Simulations used in health professions courses may include different levels of technology [5]. In pharmacy education, the

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following simulation modalities have been used: mannequins, role-playing, simulated patient instructors and computers [6]. Simulation has been used in both didactic and experiential courses in order to equip students with knowledge and skills in the following areas: dispensing safe and accurate medication, preparation of intravenous medications, disease management, medication therapy management, clinical judgment and reasoned decision-making, problem solving, communication, professionalism, and interprofessional teamwork [7].

To the best of our knowledge, the Pharm D program at the King Khalid College of Pharmacy is the only program in Saudi Arabia that uses a simulation pharmacy lab for IPPE as an adjunct to on-site training. This has helped to overcome the difficulties facing IPPE, including the shortage of clinical faculty members, hospital preceptors and advanced practice sites. Additionally, the lack of a university teaching hospital and the poor practices in local community pharmacies does not meet the course learning objectives. Additionally, the hospitals that are currently affiliated with the King Khalid University (KKU), College of Pharmacy are barely able to fulfill training position for APPEs.

In this paper, we propose a simulation pharmacy lab model as an adjunct to on-site training, and to assess its effectiveness for IPPE in a community pharmacy setting as part of the Pharm D program in Saudi Arabia.

METHODS

Course design

The IPPE Community Course is a 15-week, 4-credit hour, mandatory course offered to level 9, fifth-year Doctor of Pharmacy (PharmD) students. In order to maximize interactions between students and faculty members and to ensure student exposure to all features of community pharmacy practice, student enrollment was capped at 10 students per class. Hence, the 2018 class of 40 students was divided into 4 sections of 10 students each (Table 1). The course was scheduled to meet for 8 hours, once a week. The students alternated every week between the simulation lab and on-site training, with a total of 6 weeks simulation and 7 weeks on-site training in a community pharmacy. This paper focused on the simulation part of the course. The coursework completed prior to the fifth year included the biomedical sciences, pharmaceutical sciences, drug information (DI) and Therapeutics I and II. Students who completed the course pre-requisites, i.e., Therapeutics I and II and DI, were eligible to be enrolled.

Table 1: Demographics

Total sample *n =37* n (%)	
Sex	
Male	19 (51.3)
Female	18 (48.6)
Age (years)	
Minimum	22
Maximum	25
Mean	22.5
Standard Deviation	0.87
22	24 (64.8)
23	7 (18.9)
24	4 (10.8)
25	2 (5.4)
Nationality	
Saudi	37 (100)
Non-Saudi	0 (0)
Previous exposure to pharmacy practice (community pharmacy setting)	
Yes	3 (8.1)
No	34 (91.8)

The course was co-taught by two pharmacy faculty members with previous experience in community pharmacy practice (teaching assistant/pharmacist and assistant professor/ pharmacist). The course coordinators began creating this course approximately eight months prior to its initial implementation.

All classes were application-based sessions designed according to the assigned readings and built on previous courses and prior knowledge (mainly, the prerequisites). The course objectives were set to achieve the curriculum learning outcomes, as well as to equip students with the required skills for APPE. The course learning objectives are described as follows:

Community pharmacy course learning objectives

- Accurately process prescriptions (interpret and process medication orders accurately, completely, and efficiently).
- Correctly perform calculations to dispense and compound medications.
- Identify and use appropriate drug reference sources (utilize drug information, to retrieve drug-related information and apply that information to respond to drug information questions in the community pharmacy sittings).
- Provide effective patient education and display appropriate communication skills (communicate relevant, concise, and timely information in a clear manner using terminology and vocabulary appropriate for the intended audiences, e.g., pharmacists, technicians, health-care providers, patients, and caregivers).

Development of the simulation pharmacy

The Community IPPE course activities were divided between simulated pharmacy lab and a shadowing experience with practicing pharmacists in local community pharmacies. The ultimate goal of this simulated pharmacy lab was to standardize students 'learning experiences to ensure that they participated in all the activities aimed at achieving the course learning objectives. Additionally, the simulations created an environment that closely replicated the experiences students face during APPE programs, but in a safe learning environment. The simulation environment was carefully designed to closely mimic the environment of a community pharmacy.

The simulation pharmacy lab occupies a total of 89 m^2. A stock of 800 brand-name medications, including the top 200 over-the-counter medicines (OTC), was obtained in collaboration with the two largest government hospitals in the region. Each medicine was entered into a software system by the course instructors. In addition, hundreds of actual hand-written prescriptions were obtained from local community pharmacies to be used for the in-class activities. The simulation pharmacy lab had a computer system connected to the Internet, a thermal barcode printer (for prescription labels), and a barcode scanner (to check the stock for specific medicines).

In the middle of the pharmacy, a large five-tier shelf displays all the medications arranged by indications. Other pharmacy features include the refrigerator that is equipped with a fully electronic temperature to safely store certain medicines such as Insulin pens, a couple of electronic tablet counters, and a locked cabinet for controlled medications. A document tray holds the forms that a student might need for the in-class activities, such as a medication error report form. A small consultation room is available for private consultations.

The software applications that are installed on the computers include the drug information sources *Martindale: The Complete Drug Reference, Micromedex®*, and *Lexicomp®*. A software copy of *the Handbook of Nonprescription Drugs: An Interactive Approach to Self-Care* was also installed, along with the patient profile software *"Solution,"* since this is used by the local hospitals. Students were given access to Micromedex on their personal digital devices, such as smart phones and laptops.

Typical IPPE session

Each simulated lab session is 8 hours long and accommodates up to10 students. A typical IPPE session starts with an hour-long PowerPoint presentation to cover the didactic lecture materials. The students are given instructions and expectations for the following session. The session is facilitated by two members of the teaching staff, who also fulfill roles as actor and assessor for the patient activities.

The practical part of the session consists of five activities, with two of them involving patients. Each student has to individually complete all5 activities and submit their work to the instructor by the end of the session. These activities are as follows: (A) Accurate checking of prescription; (B) Prescription processing, completing an intervention report and labelling; (C) Dose Calculation; (D) Utilization of the drug information sources; (E) OTC product recommendation (Self Care) and patient counseling. Table 2 illustrates the IPPEs session activities and grading protocol.

A workbook containing the 5 activities, labeled from A to E, is given to the students. The allocated time for each activity is 60 minutes. However, each student rotates through the five activities in a different order. For instance, 2 students may begin with activity B and finish with activity A. This enables the IPPE session to run smoothly and ensures that all students have an

Table 2: IPPEs session activities and grading

Domain	Activity		Points awarded
Prescription management	A	Accuracy checking of prescription (clinically and legally).	/20
	B	Prescription processing and intervention report filling	/10
		Medication labeling (labeling and ancillary labels).	/10
Drug dose calculation	C	Dose Calculation	/10
Drug Information	D	Utilization the drug information sources	/20
Patient counselling and	E	OTC product recommendation (Self Care)	/10
communication skills		Patient counselling	/20
Total *			/100

**The total of 100 points to be converted to 10 marks*

equal chance to use the available facilities and resources. During the patient activity, students spend 50 min preparing for the consultation and 10 minutes conducting the consultation with the actor/patient. The instructors' role during the IPPE session is to guide the students and to assess them on the patient activity. Workbooks are collected at the end of the practical session and marked later by the instructors. At the end of each session, the instructors provide individual performance feedback to the students. They also give general feedback to the class and ask them to self-reflect on their progress over the weeks; this feedback usually takes 1.5 to 2 h.

Evaluation and assessment

Course assessment

Several activities are administered during the course to assess students' knowledge and skills and to ensure the course objectives are met and can be applied.

These include 6 practical labs (10 marks each, 60% of final grade), a written exam on the top 200 drugs (10% of final grade), a group presentation (10% of final grade), and a final practical exam (Objective Structured Clinical Examination, OSCE; 20% of final grade). A detailed description of each lab activity is summarized in Table 2. The 10-question written exam on the top 200 drugs consisted of 8 multiple choice questions and two short answer questions; these are based on the materials assigned to students as part of their self-directed study. A group presentation on a medication class was also required for the course. This group project was assessed using a grading rubric with the following specific aspects: available generic and brand names, indications, dose, dosage forms, common adverse drug reactions, patient counseling points and references, as well as organization, presentation skills, and content knowledge. The final practical exam, based on the OSCE, encompassed the 5 stations (activities) previously practiced throughout the course, with each station worth 4 marks out of the total 20 marks.

At the completion of the course, a series of evaluations were given, including an online survey of perceptions and self-confidence. The standard course evaluation was administered by the course coordinator using KKU's learning management system, Blackboard; this instrument assessed student observations on a variety of outcomes related to the simulation pharmacy lab as an instructional model in the community introductory pharmacy practice experiences (IPPEs) Course. Completion of the survey instruments was encouraged but not mandated.

Students were given a 7-question self-efficacy assessment to indicate their confidence in gaining the practical skills related to the course objectives (Table 4). For each question, students were asked to choose from the following responses: very confident, confident, neutral, unconfident, or very unconfident.

Data analysis

The collected data were cleared, entered, and analysed using the Statistical Package for Social Sciences (SPSS) version 24.0 for Mac. Results were described in terms of frequencies. A weighted mean was used to analyse the Likert scale. The following ranges were used: 1–1.80, strongly disagree;1.81–2.60, disagree; 2.61–3.40, neutral; 3.41–4.20, agree; and 4.21–5, strongly agree, Unconfident= 1-1.8, Unconfident= 1.81-2.6, Neutral= 2.61-3.4, Confident = 3.41-4.2, Very Confident =4.21-5.

Ethical approval

The Ethical Committee of Scientific Research at King Khalid University approved the research (no. ECM#2019-85), conducted as per Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research [8].

RESULTS

Overall, the course grades showed that students comprehended the material and all students passed the course. In one class of 40 students, one student achieved a grade of95%or higher (A+), 13 earned a grade of 90%or greater (A),14 students received a grade greater than 85% (B+), 4 obtained a grade of 80%or higher (B), and couple of students achieved a grade greater than 75% (C+), 70% (C), 65 % (D+), and 60% (D). Of the 40 students in the class, 37 completed the survey instrument. Most responses fell into the "confident" category with a weighted mean of (3.41 ± 0.79) (Table 3).

The evaluation administered by the course coordinator assessed student perceptions of the simulation pharmacy lab as an instructional model. Thirty-seven students who completed the course took part in this optional 7-question evaluation.

The questions used a Likert scale that allowed students to choose one of the following responses to a statement about the simulation

Table 3: Confidence rating for student self-efficacy assessment on the course objective

Statement	Very Unconfident	Unconfident	Neutral	Confident	Very Confident
Identify and retrieve any missing information upon receipt of a medication order or prescription	1 (2.7%)	6 (16.2%)	15 (40.5%)	10 (27%)	3 (8.1%)
Demonstrate familiarity with brand and generic names, appearance, manufacturer, dosage form(s), and route of administration for of the top 200 medications used in community setting	1 (2.7%)	4 (10.8%)	13 (35.1%)	12 (32.4%)	5 (13.5%)
Demonstrate the ability to process medication orders completely, accurately and efficiently. (Interpretation, selection of product, packaging and labeling)	2 (5.4%)	3 (8.1%)	15 (40.5%)	12 (32.4%)	3 (8%)
Perform calculations used in pharmacy practice accurately and in a timely manner	4 (10.8%)	4 (10.8%)	12 (32.4%)	10 (27%)	5 (13.5%)
Reply in an appropriate scientific way to the specific drug information request.	2 (5.4%)	4 (10.8%)	12 (32.4%)	13 (35.1%)	4 (10.2%)
Display effective communication skills during interactions with patients, coworkers and other health care professionals	3 (8.1%)	4 (10.8%)	9 (24.3%)	11 (29.3%)	8 (21.6%)
Conduct an efficient, effective patient interview and patient education session (counselling)	3 (8.1%)	4 (10.8%)	10 (27%)	9 (24.3%)	9 (24.3%)

Table 4: Students' responses to survey items assessing the overall experience of using simulation-based education using virtual pharmacy

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Using virtual pharmacy as a simulation-based education method was a creative, innovative, and an appropriate approach to enhance my learning and overall understanding real life community pharmacy practice	*2 (5.4%)*	*0*	10 (27%)	11 (29.7%)	10 (27%)
Taking this course in the virtual pharmacy helped me apply information learned throughout pharmacy school.	1 (2.7%)	2 (5.4%)	9 (24.3%)	10 (27%)	10 (27%)
Taking this course in the virtual pharmacy prepared me for the community rotation of APPEs	1 (2.7%)	3 (8.1%)	7 (18.9%)	11 (29.7%)	11 (29.7%)
Simulation based education using the virtual pharmacy has given me clearer picture of the role of pharmacist in community setting	2 (5.4%)	1 (2.7%)	4 (10.8%)	17 (45.9%)	9 (24.3%)
The virtual pharmacy provided a safe environment to practice	1 (2.7%)	2 (5.4%)	7 (18.9%)	14 (37.8%)	8 (21.6%)
Practicing in the virtual pharmacy helped me to develop decision making skills	1 (2.7%)	2 (5.4%)	8 (21.6%)	8 (21.6%)	9 (24.3%)
The virtual pharmacy environment simulated my interest to work in a community pharmacy	1 (2.7%)	4 (10.8%)	8 (21.6%)	13 (35.1%)	8 (21.6%)

lab: strongly agree, agree, neutral, disagree, or strongly disagree (Table 4). Overall, students "agreed" (weighted mean of 3.6±0.88) with statements about the design of the course and its ability to provide a safe learning environment to prepare them for APPE and as practitioners.

Table 5: Standard college of pharmacy course evaluation participation survey response

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
The course objectives were clear	3 (8.1%)	4 (10.8%)	13 (35.1%)	9 (24.3%)	4 (10.8%)

Topics covered in the course were well sequenced, appropriate, met course objectives, and fostered learning	3 (8.1%)	5 (13.5%)	12 (32.4%)	9 (24.3%)	5 (13.5%)
The didactic in-class lectures contributed to my learning in this course	5 (13.5%)	2 (5.4%)	13 (35.1%)	9 (24.3%)	5 (13.5%)
In class activities and demonstrations contributed to my individual learning of a specified topic	3 (8.1%)	3 (8.1%)	12 (32.4%)	11 (29.7%)	5 (13.5%)
The required textbooks and references materials additional references were helpful to my understanding of the course material	5 (13.5%)	4 (10.8%)	8 (21.6%)	10 (27%)	7 (18.9%)
The instructor explained material clearly	5 (13.5%)	7 (18.9%)	6 (16.2%)	12 (32.4%)	4 (10.8%)4
Grade assessment of this course was fair	7 (18.9%)	4 (10.8%)	12 (32.4%)	7 (18.9%)	4 (10.8%)
Feedback was regular, efficient, and helped me to reflect on my learning process	1 (2.7%)	4 (10.8%)	8 (21.6%)	15 (40.5%)	6 (16.2%)

The standard end-of-course evaluation (Table 5) was also completed by 37 students. The 8-question evaluation used a Likert scale similar to the previous one. Overall, students felt “neutral” about the course, with a weighted mean of 3.2 ± 0.92 towards the course aspects noted in Table 6."Feedback" was the only aspect of the course that students agreed to be regular and efficient.

DISCUSSION

The main purpose of establishing the virtual pharmacy at KKU was to overcome the challenges facing IPPEs: lack of a university hospital, limited training sites and preceptors, and non-standardized training, especially in the community pharmacies. The current practice at community pharmacies does not fulfill the course learning objectives in areas such as developing patient counselling and communication skills. Hence, this virtual environment was developed to provide tailored training to achieve the course learning outcomes and to equip students with the required skills to work in a community setting.

Based on student responses to the perceptions and self-confidence survey, as well as the standard end-of-course evaluation, the simulation pharmacy lab in the Community Introductory Pharmacy Practice Experiences (IPPE) Course was a success. Students were confident about completing the tasks required to practice in a community pharmacy, such as prescription management, drug dose calculation, offering drug information, and providing patient counseling using effective communication skills. Hence the course objectives were met.

Students agreed that the simulation pharmacy lab in this course was creative and innovative, and also agreed that this application-based course helped them apply the knowledge they had gained from previous courses. Additionally, they agreed that the learning environment was safe for them to practice new skills and prepared them for APPEs. The simulation lab, which was designed to mimic the environment of a community pharmacy, helped students understand the role of the pharmacist in a community setting and stimulated their interest to work in this environment.

The standard end-of-course evaluation, however, showed less satisfaction with the course. Students felt neutral towards almost all aspects of the course, such as the clearness of the course objectives, the benefits of the didactic in-class lectures, the appropriateness of the textbooks and references, the ability of the instructor to explain the course materials, and the fairness of the grade assessment. The only feature receiving high marks was regular and efficient feedback. The study findings indicate that, although students were confident in their newly developed skills and were satisfied with the simulation lab as teaching model, they were less satisfied with the course itself. This could be a result of the nature of the course, which is application-based and uses a new teaching strategy. This course requires that they step out of their traditional passive role, which is often comfortable, to fulfill new responsibilities as an active learner.

Almaghaslah *et al* noted that the use of technology and active learning methodologies in pharmacy curricula in Saudi Arabia are scarce. They also indicated that students tend to lack learning autonomy and are used to being dependent learners. Consequently, involving them in active learning activities, such simulation-based interactions, is difficult. Their conclusions further explained our students “neutral” feeling towards the application-based

course in the current study [9].

Competencies that allow them to be successful learners in a simulation pharmacy lab or other instructional teaching model. Bovill and colleagues reported that managing student resistance to change could succeed by actively listening and responding to their concerns. Thus, educator support is important, particularly in contexts where active learning is not a common practice [10].

Another important strategy to improve student satisfaction with the course is explaining the way the course is delivered, i.e., that the key role of the instructor is facilitating student learning and providing guidance, rather than playing a traditional role. Furthermore, students need to be advised at the beginning of the course to review the course manual, which explains the course objectives, and take full responsibility for reading the assigned learning materials before attending the session.

Regarding students "neutral" view on the appropriateness of the assigned textbooks, they should be informed that that these reading materials are recommended but not required. In other words, they have the freedom to use the reference that suits their cognitive level. The assessment methods utilized in this course measure higher order cognitive skills, rather than lower order skills such as memorizing and understanding. Hence, students most likely felt "neutral" towards these unfamiliar assessment methods.

Not only did this course expose students to a unique instructional learning experience, but it also laid the groundwork for a similar course to be executed at other colleges and schools of pharmacy. This will be particularly useful in Saudi Arabia, where placement sites are an ongoing challenge and few hospital preceptors are available for IPPE. The design of the simulation pharmacy lab, as well as the design of the course, may serve as a template for other pharmacy schools aiming to utilize a simulation in their IPPE. Our simulation pharmacy lab is currently also used for the IPPE in a hospital pharmacy setting, indicating that this lab could be used to provide simulations in other pharmacy settings as well.

On the negative side, establishing a simulation lab is expensive, hence other pharmacy schools might not be able to afford their own lab. To reduce the expense, the facility could be shared with neighboring colleges at a reasonable cost.

Limitations of the study

This study is not without limitations. First, the current research assessed only short-term outcomes from one course. Second, the study was conducted with a single cohort of students providing a single set of data; an in-depth understanding of students' views, particularly regarding course delivery, could have been further understood by adding a qualitative approach, thus providing triangulation.

CONCLUSION

Using a simulation pharmacy lab as an instructional model for IPPE was generally successful. This was reflected in the positive student feedback in both an online evaluation and a self-confidence survey. However, the study revealed "neutral" views regarding some aspects of the course, such as grading and the assigned learning tools. This was explained by the unfamiliar learning environment, students' resistance to a new role, and low competency in active learning methods. Overall, this paper provides a model and practical recommendations for the establishment and utilization of a simulation pharmacy lab for IPPE.

DECLARATIONS

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

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