RESEARCH ARTICLE

A comparison between student performances on objective structured clinical examination and virtual simulation

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Abstract

Objective: To compare the pharmacy students' performance on an interactive web-based virtual pharmacy tool versus in-person objective structured clinical examination (OSCE). **Methods**: The academic performance of fourth-year pharmacy students in patient interview, counseling and medication dispensing were assessed using MyDispense, a virtual pharmacy practice online case scenario, versus physical OSCE. The grades of the same students in both exams were compared, and the students were administered a questionnaire to explore their perception of virtual experience after completion of the exercise. The internal consistency and reliability of the case scenarios and questionnaire were examined by calculating Cronbach's alpha coefficient. **Results**: There was a significant increase (p = 0.01) in the average test scores of the virtual exam than the in-person OSCE. Similarly, female students had higher performance on virtual simulation than OSCE (p = 0.03). However, a comparison of the online MyDispense and OSCE assessment grades did not find a direct correlation (Spearman's rho = 0.060). The results from the self-administered questionnaire demonstrated high students' satisfaction and effective application of their knowledge through MyDispense for targeted patient interview, counseling and communication skills. **Conclusion**: The MyDispense virtual experience was well-perceived by the students as a useful online learning tool for pharmacy practice. However, there was no direct correlation between online and in-person OSCE assessment grades.

Introduction

Pharmacy practice education typically involved both the traditional classroom lectures and pharmacy practice training experience in hospital pharmacy. However, the technical advancement in recent years directs the paradigm shift from the traditional classroom to computer-based technology education (Bukoye & Shegunshi, 2016). In the 21st century, active learning, such as independent problem-based learning, is being integrated with modern technology to shape student learning (Shatto & Erwin, 2017). Recent research has reported that active learning was found to be more effective in pharmacy practice education than passive learning through traditional lectures (Maarek, 2018). In this context, teachers started engaging their students through active learning by incorporating the recent technological advancement into their curriculum (Nicol *et al*., 2018). Moreover, active learning was expected to realise the empathy for patients by the pharmacy students through pharmacy practice. Pharmacy practice experience education is the best way to prepare the pharmacy student who is seeking a career in hospital pharmacy (Coyne *et al*., 2019). Pharmacy simulation was found to

have numerous challenges, including: the need for extensive planning, highly expensive simulated pharmacy, and the requirement of many teaching staff for the supervision (Ray *et al.*, 2012). Recently, virtual pharmacy simulation has been established to overcome the above-mentioned pitfalls in pharmacy simulation which helps to meet the required training and experiential education. MyDispense, developed by the Faculty of Pharmacy and Pharmaceutical Sciences at Monash University Australia, enables students to practice the skills of a pharmacist, from a novice to highly advanced level, in a safe virtual environment that is web-based and highly accessible (McDowell *et al.*, 2016). My Dispense adopts many of the best-practice measures identified for simulation-based education, such as: feedback, deliberate practice, curriculum integration, outcome measurement, simulation fidelity, skill acquisition, and maintenance (McGaghie *et al.*, 2010). It offers the teachers the opportunity to create and validate case scenarios and saves time by providing instant grades and feedback to the students. Moreover, it provides an environment almost like objective structured clinical examination (OSCE) with the chance of committing errors and showing their consequences and changing the scenes to address different patient outcomes (McGaghie *et al.*, 2010). MyDispense has several advantages for pharmacy experiential education; however, it poses numerous challenges for implementation due to time restrictions, case complexity, randomly assigning the cases to the students might also affect the assessment of clinical competences of the student (Mak *et al.*, 2021). These challenges may significantly affect the assessment of the clinical competence of the student. To the best of the authors knowledge, no previous research has addressed the above-mentioned challenges regarding the MyDispense database. Therefore, the present study was planned to investigate the MyDispense experiential education by comparing students' grades and performance level with OSCE. Additionally, the present study aimed to explore the students' perceptions of virtual pharmacy experience.

Methods

Study type
This was an observational study.

Ethical approval
The study was approved by the local research ethics committee in the University of Tabuk, Saudi Arabia.

Subject recruitment
Both male and female students in the Fourth-year, involved in experiential education through the 'Introductory Pharmacy Practice Experience 2' course. The course deals with introducing hospital pharmacy practice skills such as prescription monitoring, patient interview, dispensing and patient counseling. All the students received an email with a detailed description of the study to obtain their willingness to participate.

Inclusion criteria
All students who replied to an email from the authors and agreed to participate were included.

Exclusion criteria
The students who did not respond to the email from the authors or were not interested in participating in the study were excluded.

Student perception questionnaire
A self-designed paper-based questionnaire consisted of ten Likert items was distributed to the students. The questionnaire was designed to assess their perceptions of virtual experience after the completion of virtual simulation exercise. The student was given opportunity to respond for each item of the questionnaire on a 5-point Likert scale. The response options were strongly agree, agree, neutral, disagree or strongly disagree. The questionnaire also comprised open-ended questions requiring the students' opinions for 'what did you like most about virtual simulation?', 'what did you dislike most about virtual simulation?' and 'what suggestion(s) do you have to improve virtual simulation?' respectively.

Assessment of reliability for case scenario and questionnaire
A pilot study was conducted to assess the reliability of case scenarios and questionnaire included in the OSCE and virtual simulation. The case scenarios and questionnaire were carefully designed and reviewed by the Faculty members in the Department of Pharmacy Practice, and the same was tested with 30 students on the internship year. The case scenarios included patient-specific information, disease-related information and medications to enable students to integrate their pharmacology knowledge, dispensing skills and counseling skills about medication errors and drug interactions (Palanisamy,

2022). The internal consistency and reliability of the questionnaire was examined by calculating the Cronbach's alpha coefficient.

Both the case scenarios and questionnaire had Cronbach's coefficient alpha > 0.9 which indicates excellent internal consistency (Cronbach, 1951).

Grade assessment

This study compared the grades of students' OSCE assessment and their online practice attempts on MyDispense programme. The students were first provided with in-person OSCE that was conducted in a simulated hospital pharmacy and then a virtual simulation through online MyDispense programme by using the same case scenario.

Parts included in the assessment

The assessment criteria for both the OSCE and virtual simulation composed of four essential components to be attempted by the students which were designed to evaluate students' skills in problem solving and oral communication. These components were patient interview, medication labelling, dispensing, and counseling. Each component carried 25% of the total marks totalling to 100%. All these components were evaluated by using similar rubrics for both the OSCE and virtual simulation and allocated the same time to complete the tasks.

Data collection

The students' grades were recorded manually for the OSCE in various stations and downloaded as an excel sheet from the MyDispense database. The responses of students to the questionnaire were collected and analysed.

Data analysis

Comparison of virtual simulation scores and OSCE

The student's t-test was used to analyse the statistical significance ($p < 0.05$) between the average scores of students in the virtual simulation and OSCE. Similarly, the student's t-test was used to analyse the virtual simulation scores between the male and female students. A correlation matrix was used to assess the relationship between the OSCE and virtual simulation scores for the total number of students. Spearman's rho tests were used

to assess the positive or negative correlation between the OSCE and the virtual simulation, $p < 0.05$ was considered as statistically significant. Statistical package for the social sciences (SPSS version 22.0) and jamovi databases were used in the analysis.

Results

The results of student performances in OSCE and virtual simulation using paired students t-test are shown in Table I. The total students' performances were significantly ($p = 0.013$) higher in virtual simulation than the in-person OSCE (Figure 1.1). Similarly, female students had higher performance in virtual simulation than OSCE (Figure 1.3) and this difference was also statistically significant ($p = 0.032$). Though the male students' performance was higher in virtual simulation (Figure 1.2), it was not statistically different ($p = 0.193$). Meanwhile, the male and female students' performances in both the OSCE and virtual simulation were compared. The result revealed that there was no statistical significant difference in student performances according to gender in both OSCE ($p = 0.812$; Figure 2.1) and virtual simulation ($p = 0.911$; Figure 2.2) (see Table I).

Table II shows the association of OSCE and virtual simulation through the correlation matrix. There was a weak positive correlation between the OSCE and virtual simulation among the total students (Spearman's rho = 0.060; Figure 3.1) and female gender (Spearman's rho = -0.154; Figure 3.2). On the other hand, male gender showed a weak negative correlation between the OSCE and virtual simulation (Spearman's rho = 0.189; Figure 3.3). However, there was no statistical significance ($p > 0.05$) between the above mentioned correlations (see Table II).

The student feedback was assessed using a self-designed questionnaire and the report implies that approximately 50% of the students strongly agreed and more than 25% agreed with all the questions mentioned in the questionnaire (Table III). The students reported high satisfaction and effective application of their knowledge through the virtual-pharmacy programme. A few students (1.4%) strongly disagreed with the questions included in the questionnaire (questions 1,3,7 and 10). Overall, very positive feedback was observed from the questionnaire.

The students felt like the real pharmacy offers more opportunity to have training on labelling, dispensing and communication. Also, the students were satisfied to play the role of pharmacists in providing patient care

Table I: Comparison of student performances between the OSCE and virtual simulation

Variables	Total (n = 69)			Male (n = 28)			Female (n = 41)			Male Vs. Female
	Mean (SD)	Median	*p value	Mean (SD)	Median	*p value	Mean (SD)	Median	*p value	**p value
OSCE	93.0 (11.42)	95	0.013	93.8 (9.71)	96.5	0.193	92.5 (12.54)	95	0.032	0.812[†]
Virtual simulation	96.9 (5.88)	100		97.1 (7.13)	100		96.7 (4.95)	100		0.911[††]

*Students' 't' test between OSCE and virtual simulation in total students, male & female; p value < 0.05 considered as statistically significant

** Students' 't' test between male & female in OSCE and virtual simulation; p value < 0.05 considered as statistically significant
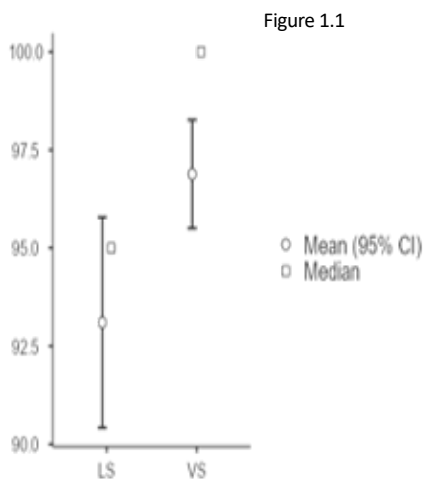
Figure 1.1

Figure 1.1: Comparison between OSCE and virtual simulation among the total students
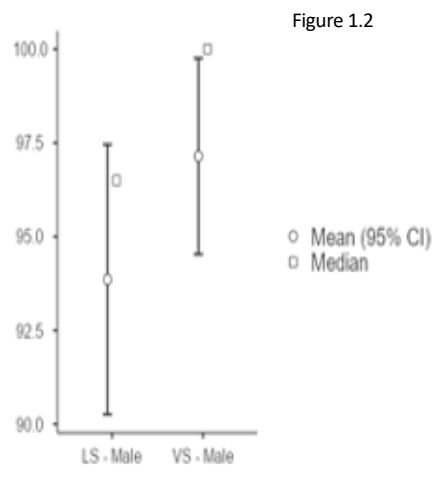
Figure 1.2

Figure 1.2: Comparison between OSCE and virtual simulation among the male students
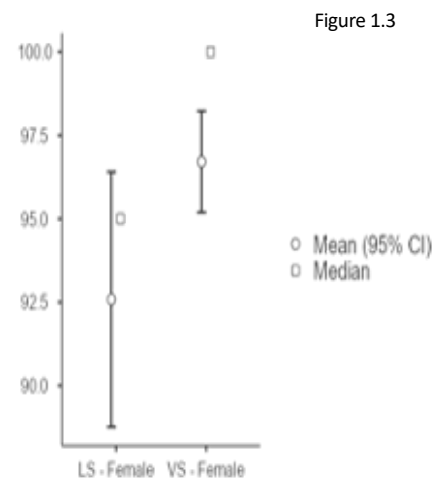
Figure 1.3

Figure 1.1: Comparison between OSCE and virtual simulation among the female students
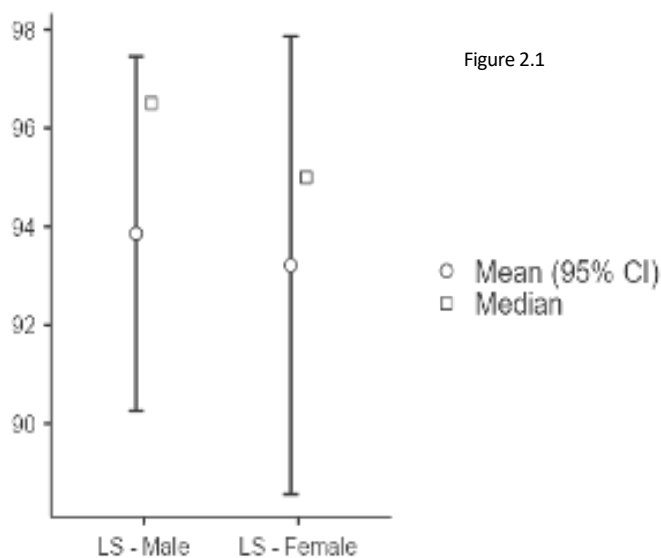
Figure 2.1

Figure 2.1: Comparison of OSCE simulation between the male and female students
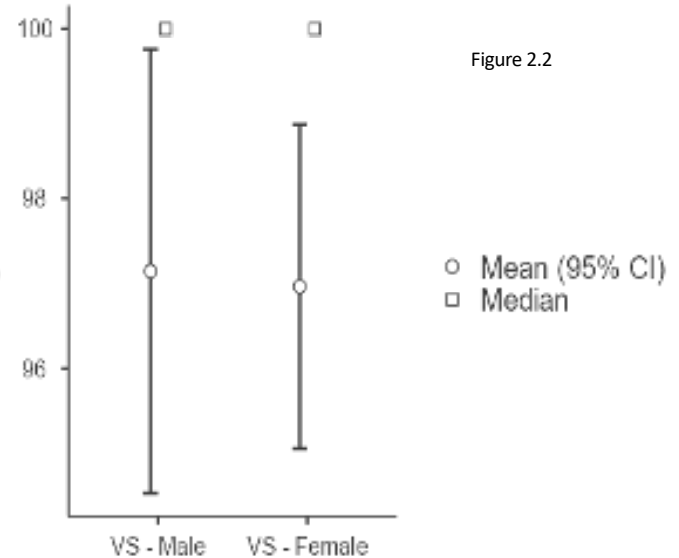
Figure 2.2

Figure 2.2: Comparison of virtual simulation between the male and female students
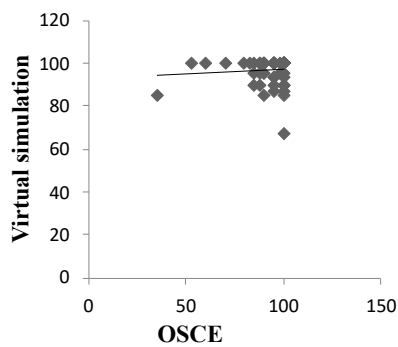
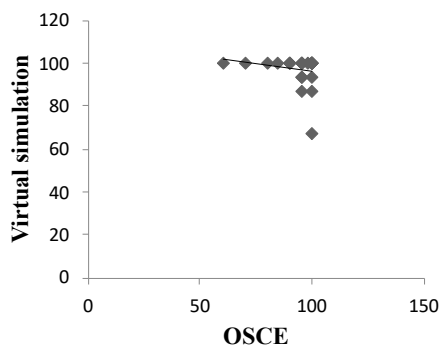**Figure 3.1: Association of OSCE with virtual simulation**

Figure 3.2: Association of OSCE with virtual simulation in male students
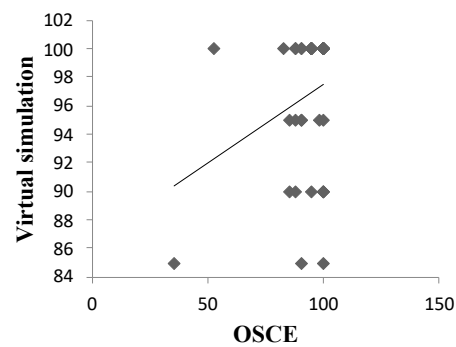

Figure 3.3: Association of OSCE with virtual simulation in female students

Table II: Association of student performances between the OSCE and virtual simulation

Subjects	*CI 95%		Spearman's correlation	
	Lower	Upper	Spearman's rho	*p* value
Total	-0.166	0.305	0.060	0.627
Male	-0.528	0.194	-0.154	0.433
Female	-0.034	0.539	0.189	0.238

*Correlation matrix; *p* value < 0.05 considered as statistically significant

Table III: Student perception on virtual simulation in a Likert Scale questionnaire (n = 69)

No	Questions	Strongly Agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly Disagree n(%)
1	The MyDispense session stimulated my interest to learn more about the hospital pharmacy	38(55.1)	26(37.7)	4(5.8)	0	1(1.4)
2	The MyDispense session was effective in improving my understanding about the hospital pharmacy	43(62.3)	22(31.9)	4(5.8)	0	0
3	The MyDispense session helped me to experience hospital pharmacy set-up	40(58.0)	(34.78)24	4(5.8)	0	1(1.4)
4	The MyDispense effectively retrieved previously learned concepts in a meaningful manner	43(62.3)	19(27.5)	5(7.2)	2(2.9)	0
5	MyDispense enhanced my confidence level in patient care	39(56.5)	23(33.3)	7(10.1)	0	0
6	MyDispense should be further incorporated into pharmacy curriculum	34(49.3)	29(42.0)	6(8.7)	0	0
7	The trainers were helpful in my MyDispense learning experience	42(60.9)	19(27.5)	7(10.1)	0	1(1.4)
8	I am satisfied with the MyDispense sessions	36(52.2)	25(36.2)	8(11.6)	0	0
9	I learned patient care in hospital pharmacy better in MyDispense	37(53.6)	24(34.8)	7(10.1)	1(1.4)	0
10	If given the opportunity, I would participate in other MyDispense activities in the future	33(47.8)	30(43.5)	4(5.8)	1(1.4)	1(1.4)

Meanwhile, some students felt that it was robotic and mentioned that MyDispense was complicated to use, had many steps, and had difficulty in searching for the drug. Moreover, the students suggested that more practical sessions were needed with more examples of drugs particularly those available in Saudi Arabia. Further, one student addressed that the speaking to the patient function could be more interactive rather than writing alone (Table IV).

Discussion

The present study aimed to explore the student performance difference between the OSCE and MyDispense in hospital pharmacy practice among the students in Saudi Arabia. The authors found that both the in-person OSCE and MyDispense virtual-patient learning methods were effective; however, the student performance on virtual simulation programme was higher than the OSCE. This finding was inconsistent with the previous finding which revealed no significant difference between the virtual simulation and OSCE (Shin *et al.*, 2018). Another study reported a higher significant

Table IV: Student perception on virtual simulation, responses to open-ended questions

What did you like most about virtual simulation?	What did you dislike most about virtual simulation?	What suggestion(s) do you have to improve virtual simulation?
- Pharmacy Simulation - It helps to improve communication skills and good simulation - It provides an opportunity to train more aspects - It helps to learn 'How to act around the patient' - It's like real Pharmacy - Experiencing that the programme provide - The different level of cases - Practicing dispensing and labelling - I learned provision of patient care by using MyDispense - It gives me a good nice experience as a pharmacist	- Complicated to use - It's a bit robotic - There are many steps - Difficulty to search the drug	- Speaking to the patient orally not only in writing - Need more drug examples - More practical - Add more drugs especially in Saudi Arabia

difference in the mean scores of students that underwent problem-based learning (8.3%; *p* = 0.001) than the virtual-patient group. However, they compared two different randomised groups of students (Al-Dahir *et al.*, 2018). Although virtual simulation has already been well-studied in pharmacy education (Benedict & Schonder, 2011; Douglass *et al.*, 2013; Benedict *et al.*, 2013), the documentation of case evaluation is scarce (Curley *et al.*, 2016). Previous studies warranted an evaluation of simulation contents before being completely adopted for the students (Ray *et al.*, 2012; Seybert *et al.*, 2012; Smithburger *et al.*, 2012; Lee *et al.*, 2014). To the best of the authors knowledge, the present study pioneered testing of case scenarios for internal consistency. Additionally, the pharmacy students in Saudi Arabia have good online skills and they prefer online exams rather than face-to-face exams (Alghamdi & Ali, 2021). The case scenarios with good internal consistency and enthusiastic students' involvement could be the reasons for high grades of the students in virtual pharmacy.

Previous studies demonstrated that the performance of students in virtual simulation has moderate (Shin *et al.*, 2018) or no significant correlation (Lim *et al.*, 2021) with their academic performance in face-face OSCE. The authors have correlated the student performances between OSCE and virtual simulation in this study. Similarly, the present study findings showed neither positive nor negative correlation between the grades of OSCE and virtual simulation grades. The authors believe that the learning experience of the students is independent of the virtual simulation, which does not represent the OSCE. Further, this study results were consistent with the previous studies showing that virtual simulation is not an option to replace or completely duplicate the OSCE (Lim *et al.*, 2021; Thompson *et al.*, 2020). Although the virtual platform offers the students more pharmacy practice exposure (Thompson *et al.*, 2020), the opportunity to assess students' communication

skills is still lacking (Lim *et al.*, 2021; Jee *et al.*, 2016). However, the MyDispense offered an opportunity to interact with the physician through the telephone regarding the medication-related problems in the prescription.

Therefore, the Likert scale questionnaire and open-ended questions were administered to assess the student perception after their virtual simulation. Most of the students responded that they were satisfied (more than 90%) with the virtual simulation experience in all the items of questionnaire. Similar responses have already been documented by the previous researchers across the Kingdom of Saudi Arabia (Alghamdi & Ali, 2021; Ali *et al.*, 2021). In this context, the students in this study were well-trained on the virtual simulation programme prior to examination and they felt comfortable navigating the exam. Lack of training in virtual simulation usually causes frustration among the students (McDowell *et al.*, 2016; Taglieri *et al.*, 2017). However, the student perception remains controversial since the previous researchers documented both positive (Douglass *et al.*, 2013) and negative feedback (Shin *et al.*, 2018) from the students regarding the virtual simulation. One student perceived that the access to virtual patient activities would improve the real-life pharmacy experience which was similar to a previous study (Lucas *et al.*, 2019). The students' responses to the both Likert scale and open-ended questionnaire reflected their confidence on virtual simulation. Hopefully, this confidence will help the students to provide appropriate patient care through hospital pharmacy practice (Shin *et al.*, 2018). A few students demonstrated their discomfort and suggestions regarding the virtual pharmacy in this study which clearly indicates that the students need more practice sessions.

Potential advantages of the MyDispense simulation were:

i)   Several tools are available to help faculty orientation to the simulation programme,

ii) Faculty members were able to use and edit the included patients database, also develop and upload new patient cases, as well as allocate patient cases to individual student or group of students,

iii) It does not require an initial investment to implement in pharmacy schools, institutions or universities,

iv) Less work is needed for case scenario maintenance or upgrades on this platform, thereby reducing the preceptors' workload post-implementation of simulation exercises. This means that case scenarios are able to be reused in the forthcoming year with minimal edits.

v) Furthermore, MyDispense has a community of pharmacy educators worldwide that assist more enhancement and development in future.

On the other hand, some limitations were also found in implementing this virtual platform:

i) Faculty teaching workload is an important consideration when implementing this programme particularly for the faculty orientation,

ii) Verbal patient counselling is limited in MyDispense

iii) Interacting with patients in a simulated environment does not fully imitates the experience of interaction with real patients in the community or hospital pharmacy environment.

Conclusion

Virtual pharmacy experience through the web-based MyDispense was well-perceived by pharmacy students. However, MyDispense, simulation tool requires a careful administration with adequate training of the students. Additionally, case evaluation in MyDispense through the validation helps to improve the quality of simulation experience. MyDispense cannot replace the physical OSCE; however, it could serve as an additional resource in pharmacy education curriculum to uplift the level of pharmacy learning experience.

Competing interests

The authors declare that there is no conflict of interest.

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