Integration of a virtual pharmacy simulation program "MyDispense" in clinical pharmacy education

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Abstract

Background: Since the outbreak of coronavirus disease (COVID-19) and with the absence of conventional social interactions, artificial intelligence and simulation become essential part of sustaining productivity around the world. MyDispense, an online pharmacy simulation, allows students to experience real-life situations in a virtual professional setting to behave as a pharmacist and undertake professional tasks.   **Aim**: The study aim was to see how MyDispense influenced pharmacy students' clinical pharmacy education outcomes.   **Methods:** A questionnaire was used to assess satisfaction, confidence and motivation, clinical experience, and decision-making among 81 students of both genders pre and post the practice.   **Results:** Pre and post-test differences in all four dimensions of the questionnaire were statistically significant ($p<0.05$).   **Conclusion:** The results obtained from this study indicate a collective improvement in the field-related knowledge of the participants, enhanced medication management performance, and a more precise application of clinical tools.

Introduction

Since the outbreak of the novel Coronavirus Disease (COVID-19), the incorporation of various social reforms has become a necessity to navigate the pandemic. Through understanding the transmission modes of COVID-19, it has become evident that reinforcement of social distancing plays a monumental role in suppressing viral spread across the community. However, while these safety measures limit contact between infected surfaces and the public, they impose negative consequences on several social systems, including education and healthcare (Teras *et al.*, 2020; Dedeilia *et al.*, 2020). This rapid change in societal practices has shifted the weight of dependence on simulations and artificial intelligence. With the absence of conventional social interactions, artificial intelligence and simulation have become an essential part of sustaining productivity around the world. In other words, it assists in re-creating real-life experiences. In essence, and as per Gaba's definition, simulation-based education is a practice that employs the versatile modalities of simulation to achieve

academic objectives (Gaba, 2004). For instance, simulation-based education allows students to react and handle real-life situations in an environment that closely replicates traditional practice, both stimulating problem-solving skills, enhancing communication between student and patient, and providing real-time access to medical records (Al-Elq, 2010). In general, the incorporation of simulation is notably present in the educational process of health sciences, and its employment is seen in a versatile range of platforms and fields, including medicine, nursing, and pharmacy. In the literature, simulation-based education approaches have been used for the instruction of technical, communication, professional, and clinical skills (Vyas *et al.*, 2012).

The approach to delivering education of clinical pharmacy has witnessed major evolvement as the demands for innovative and practical strategies of learning increase. Regarding advanced clinical pharmacy, education simulation has proved to have an active role in elevating pharmacotherapeutic knowledge as well developing patient-oriented care skills among

pharmacists and additionally has been shown to enhance student confidence during extraordinary conditions and unexpected crises (Lloyd *et al.*, 2018).

The nature of pharmaceutical practice involves the resolution of any given therapeutic dilemma through an approach of critical evaluation and specific information obtained from the patient. While students during initial education and training are exposed to aspects of medicines dispensing to develop necessary expertise, experiential environments can provide pharmacy students with a beneficial opportunity to enhance their knowledge of pharmaceutical products and become familiar with the competencies of dispensing medicines for patients. Similarly, experiential training helps trainee pharmacists develop abilities in the identification of medications through shape, packaging, and colour while also enhancing skills to interpret information displayed on the products. While it is ideal and highly recommended for students to acquire practical knowledge through experiential sites, the increasing demand on available resources for student support makes it challenging for every student to achieve this (McDowell *et al.*, 2016). As a result, some pharmaceutical schools have established a simulation system to provide wider access for students to receive education in didactic settings to address aspects of medication dispensing, disease state management, problem-solving, communication, decision making, arrangement of intravenous medications, and an elevated understanding of drug-drug interactions as well as medication errors – all combining communication skills and professionalism (Ambroziak *et al.*, 2018).

MyDispense, an online pharmacy simulation, allows students to experience real-life situations in a virtual professional setting to behave as a pharmacist and undertake tasks related to evaluation, verification, and medication dispensing, giving the student the essence of a true community pharmacy. More well known for offering students an education system that welcomes repetitive and deliberate applications, the Monash University programme allows students to gain expertise by practising different prescription types from different prescribers, exploring and choosing different labels for each drug, recording all the details electronically and reviewing the patient data with immediate feedback for structured development (Shin *et al.*, 2018). Developed as a freeware simulation tool for learning, MyDispense is open-source software that plays an active role in enhancing dispensing skills of pharmacy students along with their competence to deliver professional practice. First launched in 2010, MyDispense is currently being employed in 32 pharmacy schools all around the world (Costelloe, 2017). MyDispense has exercises that are designed to

aid tutorial outcomes and prescription management, including selecting medicinal products, dispensing controlled drugs and selecting appropriate warning labels. Simulation learning is a better way to prepare students before experiential placements in hospitals and pharmacies (McDowell *et al.*, 2016). The aim of this study was to observe the effect of learning through simulation on the knowledge of the pharmacy students in Altınbaş university from the perspectives of satisfaction with the learning, confidence and motivation, gaining clinical experience, and developing decision-making abilities.

Methods

Study design

The Turkish version of MyDispense was developed in collaboration between Altinbas and Monash University was first introduced at the University of Altınbaş in the autumn term of the year 2020 as part of the mandatory advanced clinical pharmacy practice course. An exploratory study of the analytical and quasi-experimental design was set out through the distribution and completion of a questionnaire for the students both before and after an intervention (pre- and post-test) with a total of 23 MyDispense exercises. The exercise starts by giving a brief description of the patient medical history, and then they are requested to evaluate each medication written in the prescription. The exercises are conducted on the MyDispense website, where students are required to gather and summarize all the appropriate information, including history, vital signs and the laboratory test results of the patient. Students then had to submit a final answer by writing a professional note within the online patient profile in the program regarding medications in the prescriptions if they would dispense it or not, along with the reasoning.

In the case where the student decides not to dispense the medication, they would have to suggest another medicine with a justification for their choice and call the doctor in the system to report the issue. Students are able to access the answer key and the feedback after receiving their scores. The students' data is collected as a report from MyDispense admin software, and from this report, the grading and the number of exercises completed by each student could be determined.

Setting and participants

The participants in the study were 81 students, all from the final year Bachelor of Pharmacy (BPharm) at Altınbaş university. At the start, the students were

given an orientation session where they were shown all the material necessary to comprehend the different types of the study exercises and how the dispensing happens. Before starting the course and knowing any information about the software, the students are given an online survey asking about their previous simulation pharmacy experiences if they have any. They undergo the same online survey again at the end of the term to assess their understandings of the virtual simulation program.

Data collection

A specific questionnaire was employed to explore the dimensions of simulation-based learning, with a 42-question questionnaire instrument having been employed. As for the study variables, age and gender were the only demographic related information collected; the remaining questions primarily focused on aspects of confidence, satisfaction, motivation, expertise acquired, and decision-making skills. The survey questions were expected to be answered through a gradation scale ranging between complete agreement and complete disagreement in a 5-point Likert type scale focusing on "satisfaction", "confidence", "motivation", "clinical experience", and "decision making and technical abilities". The questionnaire was not originally designed to explore the efficacy of simulation-based training on pharmacy students but was taken from a preceding quality and satisfaction study exploring the impacts of simulation-based learning on nursing students (Guerrero-Martínez *et al.*, 2020). The questionnaire was given to the participants for answering twice during the study, once during a meeting a week before the intervention and another time when the practice has been finished.

Statistical analysis

For all statistical analysis, statistical package for the social science (SPSS) 26 were used. The 95% confidence interval with $p<0.05$ and reliability test, correlation and frequency test were used to assess results. Chi-square was employed to evaluate categorised data.

Results

Demographic and clinical characteristics

The demographic characteristics of the study are inclusive of 81 students of both genders and belonging to numerous age groups. In terms of gender, male participants number was 27.2%, where female participants constituted 72.8% of all participants (n=81). As for the age group, the participants of the

study range in ages between 21 to 28 years, with 23 years being the dominant age group constituting up to 34.6% of the participants (34.6%, n=81).

Consistency of the study results

The tables represent the global pre-test and post-test results regarding the four aspects of the questionnaire, the significance and magnitude of the impact are contrasted with the valuation of the mean values and through the incorporation of hypothesis test results.

Satisfaction

The presence of a favourable significant difference was evident in the global results ($p < 0.0001$). The mean values of all the post-test scores increased compared to the pre-test scores. As for the effect on the global score, it can be described as moderate (d = 0.53), and likewise the effect on the questions holding a significant difference; all of which indicates an improvement in the score (Table I).

Confidence and motivation

Substantial, yet favourable, significant differences were seen again with the global score; where most of the items were a dominant share of the items had significant p values with the exception of three questions including "I consider that, if a teacher accompanies me during the simulation, I further develop my technical abilities", "I consider that the practical activities in simulation reduce my level of anxiety", "I feel forced to do the simulation exercise": however; it is worth noting that similar to the preceding dimensions of the items, increases were seen in regards to the mean value in the post-test scores regardless of whether the results were significant or not. The size of the effect in both global scores was small (d = 0.42), as shown in Table II.

Perception of the clinical experience

The global score, in addition to all the items, presented favourable significant differences in regards to this dimension with the exception of the two following items "The simulation is a realistic tool to learn to evaluate the real situation", "I believe the simulation is a useful learning strategy to come closer to the challenges of the real practice". The size of the effect on the global score can be considered as small (d = 0.37), with all items displaying a small effect size (Table III).

Table I: Collation of the obtained pre-test and in the post-test mean scores: The module on satisfaction

Questionnaire items	Pre-test (Mean; SD)		Post-test (Mean; SD)		Student's *t* value; DoF; *p*-value	Size of the Cohen's d Effect
1. I consider that the simulation experience has prepared me adequately	3.53	0.886	3.90	0.836	t=3.40, DoF=80 p=0.001*	0.37
2. The allotted time for the simulation was adequate	3.30	0.947	3.88	0.877	t=4.34, DoF=80 p<0.0001*	0.48
3. I am satisfied with the simulation experience	3.45	0.913	4.05	0.794	t=5.41, DoF=80 p<0.0001*	0.60
4. In general, the simulation experience improved my learning	3.45	0.794	4.09	0.766	t=5.93, DoF=80 p<0.0001*	0.65
5. I consider that the physical space in which the simulation was developed facilitates its development	3.31	0.739	3.80	0.906	t=4.03, DoF=80 p<0.0001*	0.44
6. I believe that the exercise had enough simulation elements for me to learn	3.55	0.913	3.86	0.775	t=2.86, DoF=80 p=0.005*	0.31
7. I think that the time has been enough for me to practice	3.28	1.018	3.96	0.737	t=5.47, DoF=80 p<0.0001*	0.60
8. I consider that the development of the simulation complements what was learned in class	3.34	0.856	3.83	0.839	t=4.99, DoF=80 p<0.0001*	0.55
9. I think that developing activities in simulations allows me to enrich my knowledge from the experience	3.50	0.763	4.00	0.656	t=5.03, DoF=80 p<0.0001*	0.55
10. I believe that the teacher accompanying me in the simulation improves my learning	3.55	0.727	4.13	0.682	t=5.72, DoF=80 p<0.0001*	0.63
11. I consider that the simulation I did was enough for my learning	3.29	0.814	3.80	0.802	t=4.79, DoF=80 p<0.0001*	0.53

SD: Standard deviation; DoF: Degrees of freedom; *Statistically significant results

Table II: Collation of the obtained pre-test and in the post-test mean scores: The module on confidence and motivation

Questionnaire items	Pre-test (Mean; SD)		Post-test (Mean; SD)		Student's *t* value; DoF; *p*-value	Size of the Cohen's d Effect
1. My experience with the simulation increased my level of confidence to face the real setting	3.43	0.991	3.70	0.947	t=2.35, DoF=80 p=0.021*	0.26
2. Conducting the simulation motivated me to learn	3.63	0.891	3.85	0.748	t=2.20, DoF=80 p=0.031*	0.24
3. The simulation gave me confidence in my technical abilities	3.59	0.896	3.88	0.891	t=2.79, DoF=80 p=0.007*	0.31
4. I consider that, if a teacher accompanies me during the simulation, I further develop my technical abilities	3.60	0.628	3.78	0.871	t=1.62, DoF=80 p=0.109	0.18
5. I consider that the teachers foster the simulation to improve my learning	3.56	0.709	3.86	0.759	t=3.00, DoF=80 p=0.004*	0.33
6. I believe that the practical activities in simulation increase my level of confidence	3.60	0.880	3.86	0.882	t=2.53, DoF=80 p=0.013*	0.28
7. I consider that the practical activities in simulation reduce my level of anxiety	3.41	1.015	3.54	0.885	t=0.971, DoF=80 p=0.335	0.10
8. I am free to attend the development of the simulation	3.35	0.765	3.56	0.953	t=2.15, DoF=80 p=0.034*	0.23
9. I feel forced to do the simulation exercise	2.99	0.934	3.21	1.144	t=1.69, DoF=80 p=0.095	0.18
10. I easily recognize the objectives of the simulation and the reasons to conduct it	3.39	0.720	3.93	0.708	t=5.33, DoF=80 p<0.0001*	0.59
Mean score of the confidence and motivation module	3.45	0.629	3.71	0.566	t=3.83, DoF=80 p<0.0001*	0.42

SD: Standard deviation; DoF: Degrees of freedom; *Statistically significant results

Table III: Collation of the obtained pre-test and in the post-test mean scores: The module on the perception of the clinical experience

Questionnaire items	Pre-test (Mean; SD)		Post-test (Mean; SD)		Student's *t* value; DoF; *p*-value	Size of the Cohen's d Effect
1. The simulation is a realistic tool to learn to evaluate the real situation	3.56	0.939	3.75	0.893	*t*=1.53, DoF=80 *p*=0.129	0.17
2. The scenarios used with the simulation recreate real-life situations	3.63	0.848	3.89	0.886	*t*=2.25, DoF=80 *p*=0.027*	0.25
3. The simulation scenario was realistic	3.45	0.692	3.93	0.911	*t*=4.27, DoF=80 *p*<0.0001*	0.47
4. The pace of the simulation reflected the flow in a real setting	3.44	0.709	3.84	0.878	*t*=3.67, DoF=80 *p*<0.0001*	0.40
5. I believe the simulation is a useful learning strategy to come closer to the challenges of real practice	3.69	0.963	3.93	0.897	*t*=1.92, DoF=80 *p*=0.058	0.21
6. I consider that the simulation allows me to learn in a realistic context which mimics the care provided to the patient	3.51	0.779	3.79	0.852	*t*=2.51, DoF=80 *p*=0.014*	0.27
7. I believe that the simulation mimics the care provided to the patient in a safe and controlled setting	3.59	0.669	3.89	0.746	*t*=3.34, DoF=80 *p*=0.001*	0.37
Mean score of the perception of the clinical experience	3.55	0.689	3.85	0.738	*t*=3.39, DoF=80 *p*=0.001*	0.37

SD: Standard deviation; DoF: Degrees of freedom; *Statistically significant results

Perception of the decision making and technical abilities

Favourable significant differences were achieved comprehensively in all the scores (*p* < 0.0001). The magnitude of the effect in the global score was moderate (d = 0.56), where it was seen alternating between small and moderate in the questions (Table IV). Furthermore, there was a large increase in the mean marks of the students between the first week of the practice and the last week. The improvement in the student performance and the changes in their marks were clearly significant over time (*p*<0.05*). Table V shows the mean, standard deviation and *p*-values according to the marks of the students during the practice weeks.

Table IV: Collation of the obtained pre-test and in the post-test mean scores: The module on the perception of the decision making and technical abilities

Questionnaire items	Pre-test (Mean; SD)		Post-test (Mean; SD)		Student's *t* value; DoF; *p*-value	Size of the Cohen's d Effect
1. The simulation is a realistic tool to learn to evaluate the patient in a real setting.	3.49	0.729	3.85	0.797	*t*=3.49, DoF=80 *p*=0.001*	0.38
2. My experience with the simulation improved my technical abilities.	3.48	0.693	3.96	0.787	*t*=4.99, DoF=80 *p*<0.0001*	0.55
3. The scenarios develop critical thinking and decision making.	3.59	0.867	4.01	0.703	*t*=4.82, DoF=80 *p*<0.0001*	0.53
4. The prioritization abilities taught by using the simulation are adequate.	3.39	0.738	3.93	0.689	*t*=5.50, DoF=80 *p*<0.0001*	0.61
5. My interaction with the simulation improved my clinical competence.	3.40	0.756	3.91	0.799	*t*=5.36, DoF=80 *p*=0.000	0.59
6. The simulation allowed me to put theory into practice	3.38	0.769	3.95	0.692	*t*=5.90, DoF=80 *p*<0.0001*	0.65
7. The experiences with the simulation helped me to determine priority aspects in pharmaceutical care.	3.60	0.866	3.98	0.711	*t*=3.70, DoF=80 *p*<0.0001*	0.41
8. The simulation helped me handle the clinical emergencies effectively	3.30	0.786	3.69	0.805	*t*=3.50, DoF=80 *p*=0.001*	0.38
9. My experience in the simulation gave me confidence in my technical abilities.	3.48	0.711	3.91	0.799	*t*=4.27, DoF=80 *p*<0.0001*	0.47
10. I consider that the practical activities developed in the simulation are significant for the development of technical abilities.	3.60	0.866	3.94	0.752	*t*=3.35, DoF=80 *p*=0.001*	0.37
11. I consider that repeating actions in the simulation hones my technique to handle the patient.	3.60	0.686	3.94	0.769	*t*=3.52, DoF=80 *p*=0.001*	0.39

Questionnaire items	Pre-test (Mean; SD)		Post-test (Mean; SD)		Student's *t* value; DoF; *p*-value	Size of the Cohen's d Effect
12. The simulation improves my ability and capacity to apply my knowledge in different situations	3.70	0.892	3.90	0.739	*t*=2.02, DoF=80 *p*=0.046*	0.22
13. I consider that the simulation allows me to make decisions on the care provided to the patient.	3.64	0.830	3.98	0.711	*t*=3.58, DoF=80 *p*=0.001*	0.39
14. The clinical simulation allowed me to develop abilities in assertive communication with the multidisciplinary team.	3.51	0.941	3.84	0.787	*t*=3.16, DoF=80 *p*=0.002*	0.35
Mean score of the perception of the decision making and technical abilities	3.51	0.688	3.91	0.649	*t*=5.04, DoF=80 *p*<0.0001*	0.56

SD: Standard deviation; DoF: Degrees of freedom; *Statistically significant results

Table V: The improvement of the students' performance during the practice weeks (n:81)

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Mean	72.95	90.59	96.52	92.47	91.83	92.74
SD	24.03	16.14	15.56	12.54	9.40	10.11
p-value	0.071	<0.0001*	<0.0001*	0.024*	0.010*	<0.0001*

SD: Standard deviation; *Statistically significant results

Discussion

This study attempted to assess the attitude of students to the introduction of simulation-based learning in terms of satisfaction and confidence. Students displayed instantaneous inflation in comfort levels regarding all modules of the survey. Following analysis conducted on individual items of the questionnaire, and after taking into consideration the results, it becomes evident that an improvement in the collective scores of the survey dimensions is achieved, supporting the successful impact of simulation-based learning and enhancement of experience for students. This can be illustrated by estimating the statistical significance of the individual items by taking into consideration the *t* and *p* values as well as the size of Cohen's d-effect. In regards to the effect size observed globally of the 4-dimensional questionnaire, the scores achieved are relatively small in regards to the reference values ("confidence and motivation" and "perception of the clinical experience") and moderate for "satisfaction" and "perception of the decision making and technical abilities", similarly for the majority of the specific items. Likewise, the favourable significant difference was evident in all the four dimensions of the study.

Overall, students displayed sufficient satisfaction following their experience with simulation-based learning throughout the course, as indicated by the mean scores of both the pre-test and post-test values. In a study conducted by Motala and his colleagues, there was variation in the level of confidence regarding practice and skills among student participants preceding and following simulation exercises. The lower scores obtained in the questionnaire preceding simulation could be attributed to the lack of exposure to the simulation technique that cultures a preference for more traditional approaches to education and training (Motala & Van, 2016). Regarding the confidence and motivation component, the collective score of skill confidence showed an increase in mean score from 3.45 to 3.71 in scale values (*p* < 0.0001). Similar results were obtained in one study with reported inflation in the skill confidence score from 44.0 to 56.2% following the introduction of a simulation-based educational intervention (*p* < 0.001) (Turatsinze *et al.*, 2020).

In an additional study conducted to evaluate the effect of simulation-based learning in a virtual program on third-year pharmacy students, it was concluded that 78% of the students displayed an improvement in the clinical skills and overall competence in the practice as well as problem-solving abilities; all of which was attributed to increasing in confidence (Kirwin *et al.*, 2013). In a study conducted by Simeon Turatsinze and colleagues, it was concluded that the intervention of simulation learning has a direct positive impact on learner confidence; additionally helping students capture a real picture of the responsibilities and roles of a pharmacist in a given medical emergency hence preparing them for working under pressure in more demanding work environments (Turatsinze *et al.*, 2020).

Shifting the focus to the third dimension of the questionnaire, which focused on the clinical experience acquired by pharmacy students, the authors can see a significant improvement between the pre-and post-

test scores with a moderate score for Cohen's d effect. Other studies have been conducted using similar incentives have concluded that simulation-based learning has a direct positive relationship with clinical and professional skills where students were exposed to real-life professional settings. Additionally, simulation-based learning can play a substantial role in enhancing the efficiency of the overall learning process for students (Gamboa Mahecha *et al.*, 2013). In a study conducted in 12 low and middle-income countries, including African, Latin American and Asian countries, the impact evaluation of simulation-based learning on increasing interprofessional communication and the decision making abilities was shown (Shilkofski & Hunt, 2015). Similar results can be seen in our study as students displayed an enhanced performance in terms of decision making and commitment to the process, from identifying labels and products to the direction of use and general knowledge, which is one of the main principles of MyDispense goals (Klitsie,2019). Furthermore, objective data corroborated the subjective data acquired by this questionnaire, as the students' ability to make drug therapy dispensing decisions improved significantly, as seen by their improved weekly grades ($p < 0.05$).

Limitations

The sample size was small, and hence the next step should be focused on evaluating the execution of the training package and validation of the methodology with a bigger cohort of students.

With the assistance of Google Forms, the authors were able to collect the responses; and as a result, the discussion of opinions should be performed with caution.

Furthermore, the survey did not cover some topics, such as the impact of pandemic lockdown on the internship in pharmacy and hospital settings, as well as neglecting to explore the student perspectives on the future of simulation-based training.

Conclusion

While online education has been around for several decades, the novel COVID-19 triggered a surge in its relevance and put its value and the consequential need to administer and regulate the field under the limelight. MyDispense stands out by highlighting best-practice requirements in simulation-based training in the pharmacy field. Regardless of the absence or presence of past experience in the field, pharmacy students collectively agreed to the benefits of simulation on their learning process. A substantial period of time and

effort was dedicated by the lecturer to establish novel cases, all of which served as a valuable opportunity for study students in their pharmacy practice residents by extension. The results obtained from this study indicate a collective improvement in the field-related knowledge of the participants, enhanced medication management performance, and a more precise application of clinical tools.

The study implies the necessity of incorporating simulation-based education into the curriculum of pharmacy schools and training the staff on its use. Likewise, clinical pharmacists should play their roles in the development of the practice through implementing clinically-based problems and establishing challenging cases and scenarios in an attempt to nurture the clinical experience of pharmacy students.

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