Saudi Pharmaceutical Journal 28 (2020) 1075–1083

Contents lists available at ScienceDirect

Saudi Pharmaceutical Journal

journal homepage: www.sciencedirect.com

Original article

Investigating the impact of COVID-19 lockdown on pharmaceutical education in Saudi Arabia – A call for a remote teaching contingency strategy

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ARTICLE INFO

Article history:
Received 6 June 2020
Accepted 28 July 2020
Available online 3 August 2020

Keywords:
COVID-19 lockdown
Pharmaceutical Education
Remote teaching
Teaching contingency strategy

ABSTRACT

Background: COVID-19 lockdown has forced pharmacy education to be conducted remotely for approximately half of the second semester in the year 2019/2020. This sudden shift to distance learning has put the pharmacy education system through an extraordinary experience that may impact its future.
Objective: To investigate the effect emergency remote teaching has had on pharmacy education in Saudi Arabia, and to provide recommendations that may help set in place a contingency strategy.
Methods: Two cross-sectional Likert-scale based questionnaires targeted at students and teachers separately, designed to explore stakeholders' satisfaction in three areas of emergency distance teaching/learning: The use of virtual classrooms, completion of course learning outcomes (CLOs) and assessment via alternative methods during the COVID-19 lockdown period. Furthermore, phone interviews were conducted with teachers and students to discuss results from both questionnaires for further clarity on teacher and student views.
Results: Over 700 pharmacy students, from 19 different local colleges, and 74 faculty members from 10 different local colleges have participated in this study. While it was challenging for the majority of teachers (>60%) to delivery complex scientific concepts over virtual classrooms, >35% of students and 60% of teachers have expressed concerns on the lack of student–student and student–teacher interactions. A factor that has shown a significantly negative correlation with student overall satisfaction ($p < 0.01$). Emergency remote teaching has forced teachers to alternative assessment methods, which the majority (70%) believe had a positive effect on students' overall skills. Almost half of students (45%) were concerned by the lack of guidance accompanied by unfamiliar methods of assessments.
Conclusions: Based on statistically analysed results from cross sectional Likert-scale questionnaires aimed at stakeholders of pharmaceutical education, this study concludes with a number of recommendations that may help pharmacy colleges seize this unique opportunity to further enhance the quality of pharmacy education in Saudi Arabia.

1. Introduction

Prior to 2001, the college of pharmacy At King Saud university was the only college that offered an undergraduate pharmacy related degree program in Saudi Arabia (Alhamoudi and Alnattah, 2018). Since then, a sharp increase was observed in the number of pharmacy colleges (Alhamoudi and Alnattah, 2018). According to a report published by the Saudi Commission for Health Specialities (SCFHS, 2018) the number of pharmacy colleges in Saudi Arabia has reached 27 in 2018 hosting over 14,000 students (SCFHS, 2018). This came as a result of a government funded and managed mission of advancing higher education in the country to meet national demands in various sectors, such as healthcare and the pharmaceutical industry (Alhamoudi and Alnattah, 2018). While pharmaceutical education in Saudi Arabia is relatively young, compared to that of other countries such as the UK and the USA, it has witnessed a significant growth and development in its quality, due to the continuous revision and standardization process encouraged by various boards and councils (Asiri, 2011) such as the national

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Production and hosting by Elsevier

https://doi.org/10.1016/j.jsps.2020.07.008
1319-0164/

centre for academic accreditation and evaluation (previously known as NCAAA). Furthermore, experts in the field in Saudi Arabia, have recently started to publish their experiences in developing pharmaceutical education as part of acquiring national and international accreditations (Alkatheri et al., 2019). According to the Accreditation Council for Pharmacy Education (ACPE), so far, four Doctor of Pharmacy (Pharm D) programs offered in Saudi Arabian institutions have been accredited internationally (ACPE, 2020).

The challenge all educators in Saudi Arabian institutions and around the world are currently tackling is the sudden shift to distance learning enforced as a measure to prevent the spread of COVID-19. From the 8th of March 2020 the Saudi Arabian ministry of education has directed all schools, colleges, and universities in the country to indefinitely suspend student attendance, and to activate distance learning as an alternative. Henceforth, teaching was carried out remotely and replaced by virtual classrooms. This was possible via online learning management systems such as Blackboard and Microsoft Teams. Universities around the country spent great efforts launching a variety of online training sessions and providing basic manuals to equip academics for online teaching. This all started taking place after 7 weeks into the second term, where a minimum of 8 weeks of teaching remained. As directed by the minister of education and university presidents, program management teams across all universities in Saudi Arabia have held emergency meetings to handle this sudden change of teaching strategy. The common goal was to ensure quality of teaching is maintained by assessing all course learning outcomes (CLOs) and using appropriate methods that account for the limitations of remote teaching. Furthermore, to ensure student satisfaction, the ministry of education, through university admissions, has directed all program management teams to modify the distribution of assessments, assigning 80% of the total course mark to coursework related activities, with the remaining 20% allocated to final assessments. Lecturers were given a wide range of evaluation methods to choose from. For coursework related activities, examples include reports, essays and student presentations. The final assessment included oral examinations, open book examinations, and online multiple-choice questions.

Although most pharmacy program management teams did not have a contingency plan in place for such circumstances, with the guidance of the ministry of education and university managerial teams, the teaching and assessment periods of the second term in the academic year 2019/2020 were successfully completed. Whilst measuring the level of success for this accomplishment may be possible through established program key performance indicators, this study investigates the effects these extraordinary circumstances have had on pharmacy education. Here the author acquires both student and teacher feedbacks on the experience, its difficulties and successes. This study aims to help in forming a basis for developing a contingency strategy for emergency remote teaching in the field of pharmaceutical education in Saudi Arabian universities.

2. Methods

A cross sectional pharmacy student-targeted online questionnaire was developed using google forms. In attempts to ensure only pharmacy students' response, an opening question of the program name was used to filter out non-pharmacy students. Followed by a few demographical questions as well as determining the institution's name and program year in which the participant is currently in.

The questionnaire was designed to measure students' satisfaction, using 5 point Likert-scale questions (Joshi et al., 2015), in three different areas: **Virtual classrooms**, **Completion of course learning outcome (CLOs)** and **Alternative assessments.** The experience of graduating students was also explored via questions on **Pre-registrational training** during the lockdown phase. In each area, the questionnaire was designed to identify major challenges and obstacles students have faced during the distance learning. Furthermore, participants were provided with an ending segment to add any relevant comments. As part of the development process, the questionnaire was revised and amended post pilot testing on a group of volunteer students.

A second teacher-targeted cross-sectional questionnaire was developed to measure their satisfaction in the same three areas of interest. To avoid participations from academics in all areas, the questionnaire was adapted with an opening filtering question considering only faculty members that have participated in teaching and assessing pharmacy students, in Saudi Arabian institutions, during the lockdown. The questionnaire included ending segments to allow teachers to further add any comments or suggestions they see fit. The questionnaire was put through a pilot test by a group of volunteer academics to revise and amend. The study was reviewed and approved by the ethics committee of Taibah University.

2.1. Data collection

Using the electronic platform "Google Forms" both questionnaires were sent to 27 different institutions in Saudi Arabia. The teacher-targeted questionnaire was directed to pharmacy program managerial teams for distribution amongst faculty members, whilst the student-targeted questionnaire was directed to student group leaders to distribute amongst pharmacy students from all program years. Both questionnaires were conducted during May 2020.

Awarded student marks, from the past three years, in four randomly selected courses in different areas of pharmaceutical sciences, were collected from consenting volunteer faculty members. Student names and ID numbers where erased to protect their privacy.

2.2. Interviews with participants

To further clarify the students' and teachers' voices and comments from open-ended questions, individual interviews were conducted remotely with three students and four teachers from the college of pharmacy in Taibah University. In the interviews, results from both questionnaires were discussed with all participants. Conclusions were drawn, recorded, and used in both the results and discussion parts of this study.

2.3. Data analysis

Diverging stacked bar charts were used to help present results from Likert-scale questions in both questionnaires. Awarded marks as well as student satisfaction scores were presented using a box plot. Coefficient analysis between students' satisfaction and variables of Likert-scale ordinal output data, was conducted using non-parametric Spearman's rank correlation on IBM® SPSS statistics software.

3. Results

Responses from the student-targeted questionnaire included 703 students from 19 different Saudi Arabian colleges, covering most Saudi Arabian regions, 21% of which were from Taibah University (Table 1). This included students from all levels and stages of undergraduate programs, Pharm D and Bachelor of

Table 1
Demographic details of participants in both questionnaires (n = 777). Data collection was completed through google forms. As the links to the teacher-based questionnaire and student-based questionnaire were sent directly to program management teams and student leaders respectively. Out of the 27 targeted pharmacy colleges in the country, 703 students from 19 different institutions and 74 academics from 10 different institutions have responded. Student sample is representative of the population in terms of gender, program title and year of program. The academics sample includes all teaching positions.

Variables	No. of participants (%)	
	Students	Academics
Gender		
Male	414 (58.89)	54 (72.97)
Female	289 (41.11)	20 (27.03)
Program title		
Pharm D	492 (69.99)	–
B Pharm	211 (30.01)	–
Program year		
1st	90 (12.80)	–
2nd	81 (11.52)	–
3rd	101 (14.37)	–
4th	91 (12.94)	–
Pre-registration training	340 (48.36) *	–
Institution name		
Albaha University	44 (6.26)	9 (12.16)
Al-Rayan Colleges	10 (1.42)	1 (1.35)
Batterjee Medical College	25 (3.56)	–
Ibn Sina National College for medical studies	9 (1.28)	–
Imam Abdulrahman Bin Faisal University	6 (0.85)	–
Jazan University	9 (1.28)	–
Jouf University	23 (3.27)	–
King Abdulaziz university	69 (9.82)	1 (1.35)
King Khalid university	31 (4.41)	13 (17.57)
King Saud bin Abdulaziz University for Health Sciences	1 (0.14)	–
King Saud University	39 (5.55)	5 (6.76)
Northern Border university	41 (5.83)	3 (4.05)
Prince Sattam bin Abdulaziz University	–	5 (6.76)
Princess Nourah Bint Abdulrahman University	63 (8.96)	–
Shaqra University	29 (4.13)	–
Taibah University	148 (21.05)	28 (37.84)
Taif University	50 (7.11)	–
Umm Al-Qura University	36 (5.12)	7 (9.46)
University of Hail	52 (7.40)	–
University of Tabuk	18 (2.56)	2 (2.70)
Job title		
Assistant Teacher	–	5 (6.76)
Lecturer	–	10 (13.51)
Assistant Professor	–	39 (52.70)
Associate Professor	–	13 (17.57)
Professor	–	7 (9.46)

* Students from the pre-registrational training phase were directed to the training section of the questionnaire as they have not been taught during the COVID-19 lockdown.

Pharmacy (B Pharm), including the pre-registrational training year (Table 1). Student sample size represents approximately 5% of the population, as the total number of undergraduate pharmacy students in Saudi Arabia is estimated at 14,004 (SCFHS, 2018). The teacher-targeted questionnaire on the other hand, yielded only 74 academics from 10 different colleges (Table 1). Assuming a student to teacher ratio of 18 to 1, as stated by the ministry of education to be the average student to teacher ratio in Saudi Arabian colleges (MOE, 2011), the author estimates the total number of members in pharmacy faculties to be 778, therefore the teacher based sample in this study represents an estimated 10% of their population. Although a higher percentage of teachers than students have participated, the number of colleges represented in the teacher-targeted questionnaire output is much lower. This may indicate that teachers were occupied with post-teaching activities such as the submission of course portfolios. Additionally, the author has noticed many circulated research-based questionnaires investigating varies aspects in relation to COVID-19, this may have lowered participation interest in general.

Results from the 5-point Likert-scale questionnaires were presented using diverging stacked bar charts in Figs. 1 and 2 for students and teachers, respectively. Participants with neutral responses were positioned at the centre of the horizontal axis. Agreeing and disagreeing participants where positioned on the right and left sides of the horizontal axis, respectively. Responses to various statements were grouped under 4 main categories: Virtual classrooms, Course Learning Outcomes (CLOs), Alternative assessment methods (Fig. 1&2) and Training via alternative activities (Fig. 1 only).

3.1. Interviews with teachers and students

Individual interviews were conducted remotely with three students and four teachers all from the college of pharmacy at Taibah University. These interviews included a discussion on questionnaires output, specifically comments and ideas posted by participants in open-ended questions. Results from interviews has been incorporated into the following sections.

3.2. Virtual classrooms

Results show > 20% of students and > 30% of teachers reported difficulties with internet connection, and thus attending and maintaining presence in virtual classrooms (Fig. 1&2). While attendance may be an issue for some, most teachers (>60%) agree that it was difficult to use distance learning tools in delivering complex scientific concepts (Fig. 2). Student-teacher interactions were reported to be limited, by > 35% of students and almost 60% of teacher participants, causing difficulties for students to understand lecture content (Fig. 1&2). Interviews with some of the student representatives have also revealed that, in virtual classrooms, student–student interactions have also been limited, thereby limiting peer collaborations which otherwise many students depend on in normal circumstances.

Approximately 35% of students agree that it was more difficult to concentrate during virtual classrooms, rendering them less effective (Fig. 1). Furthermore, student representatives in an interview have explained that although a student maybe signed into a virtual classroom, they may be distracted by other applications especially if they are attending via their smart phones.

While very few teachers have reported previous experience with virtual classrooms, for the majority, this was their first attempt of being on the teaching side (Fig. 1). Learning how to use new tools and coping with the pressures of distance teaching has split teacher opinion on whether such tools are appropriate for pharmacy related subjects (Fig. 1).

3.3. Course learning outcomes

Due to not being able to attend laboratories, psychomotor based CLOs were not completed. In addition, approximately 20% of teachers have admitted to not being able to completely cover CLOs (Fig. 2). >35% of students believe they have gained limited knowledge and skills, similarly, almost 40% of teachers believe that students have not gained all essential knowledge and skills during the lockdown period (Fig. 1&2).

>57% of students and 45% of teachers have shown interest in the idea of conducting revision sessions for essential course learning outcomes next semester (Fig. 1&2).

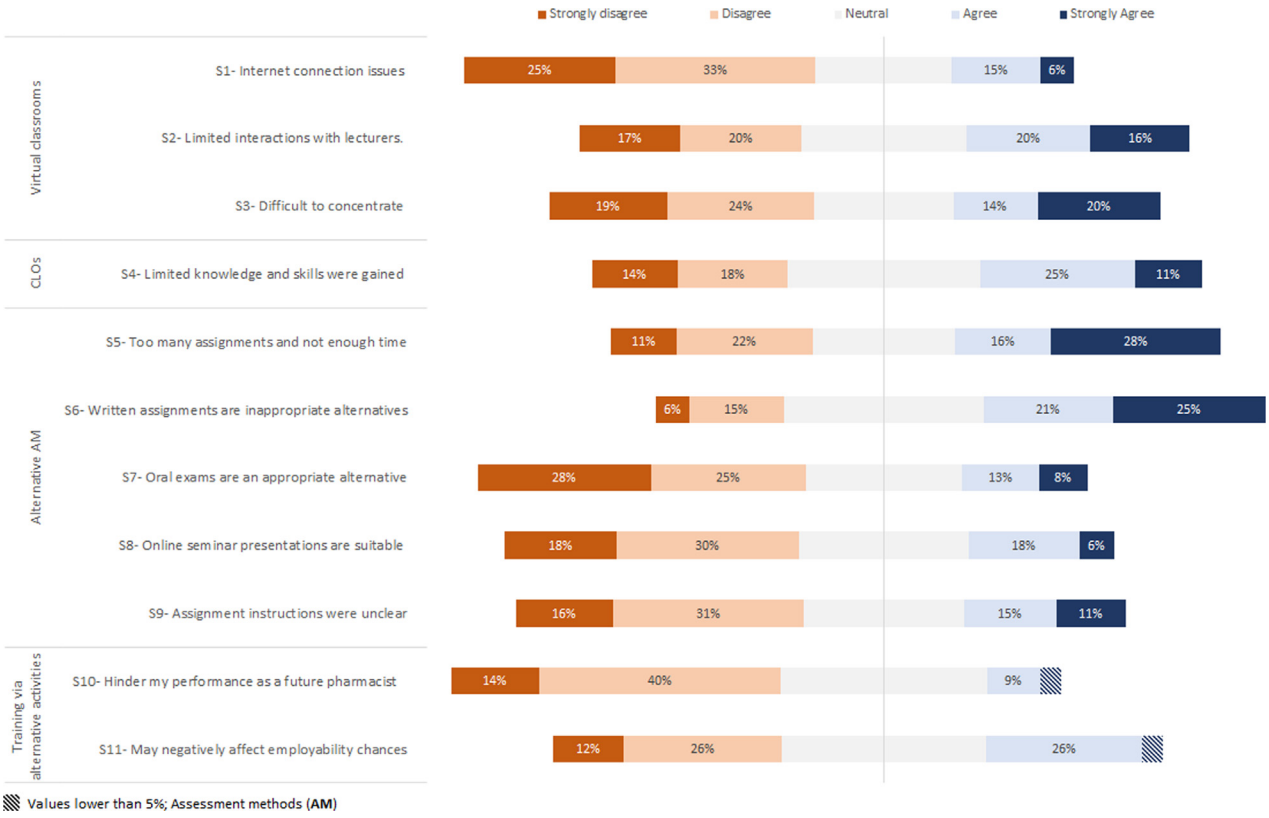

Fig. 1. Diverging stacked bar chart to show results from a 5-point Likert-scale student-targeted questionnaire to measure student level of agreement with several statements in 3 categories concerned with the educational process during COVID-19 lockdown, these included: **Virtual classrooms**, **Completion of CLOs and Alternative assessment methods** (n = 363). Graduates were also asked to participate with their feedback on **Training via alternative activities** (n = 340). Full statements from the questionnaire were abbreviated above due to limited spacing. Full statements are as follows: **(S1)** I struggle with attending virtual classrooms due to internet connection problems; **(S2)** With remote teaching I have had limited interactions with teachers causing difficulties in understanding the lecture materials; **(S3)** Virtual classrooms are ineffective as one can easily be distracted; **(S4)** During COVID-19 lockdown I was unable to absorb all knowledge and skills associated with this term and as a result I fear it will affect my performance as a pharmacist in the future; **(S5)** Number of assignments requested during the COVID-19 lockdown were very high with limited time for completion; **(S6)** Witten assignments such as essays and reports were not suitable for this duration as they're very time consuming and require a lot of effort; **(S7)** Oral exams were a suitable alternative to written exams as they allow demonstration of knowledge and skills with ease; **(S8)** Online seminar presentations are suitable alternative methods of assessment; **(S9)** I had difficulty understanding the required actions for the assessment methods used during the lockdown; (**S10**) Completing training program requirements with alternative activities will negatively impacts my future professional performance; **(S11)** Completing training program requirements with alternative activities will reduce my chance of obtaining a job.

3.4. Alternative assessment methods

While the most common conventional method of assessment may be written examinations, the lockdown period has necessitated alternative remote methods. In addition to online multiple-choice question (MCQ) exams, teachers have resorted more to assessment via written assignments and online oral examinations. This new experience has alerted teachers to the benefits of these alternatives, as 70% believe they can enhance student overall skills (Fig. 2). This has prompted the majority of teachers (>60%) to consider a reduction in the number of exams while increasing alternative methods of assessment for courses in the future (Fig. 2).

While teachers were split on the practicality of online examinations, most students did not favour written assignments and oral examinations (Fig. 1&2). Student representatives in interviews explained that many students had limited experience in writing essays and or reports, therefore undergoing such assessment required a substantial effort, especially when a plagiarism check is required. Furthermore, they explain that oral exams were very difficult to prepare for, as the scope of the exam can be very wide. In many cases students were not presented with what to expect in an oral exam, thus preparations and revision were less effective. A lower proportion (<25%) of students were unfavourable to assessment by online seminar presentations, while some may have struggled due to poor internet connections (Fig. 1). Student representatives attribute this response to the limited experience students have in giving presentations in general.

Students have also shown concern towards the high number of assignments given during this lockdown. Student representatives explained in interviews that a sudden influx of assignments was pushed in a very limited period. A student representative stated the following in an interview: *"We believe that each teacher was unaware of the assignments given to us by his colleagues*". Suggesting they wanted some informed knowledge, as assurance, on college oversight of academic staff in terms of managing the total number of assignments.

Approximately 25% of students claimed to face difficulties in understanding the requirements of some assessment methods (Fig. 1). Furthermore, several student interview participants have claimed that the evaluation criteria for some assessments were unclear, which they believe caused some of the marking processes to be susceptible to subjectivity. Others have commented that not fully understanding the reasons behind loss of marks has caused students distress and the feeling of unfairness. When students were asked whether assessments performed during lockdown were fair and proportionate, almost 40% answered "No" (data not presented). However, when comparing student marks for the past three years (Fig. 3) the cohorts assessed during COVID-19

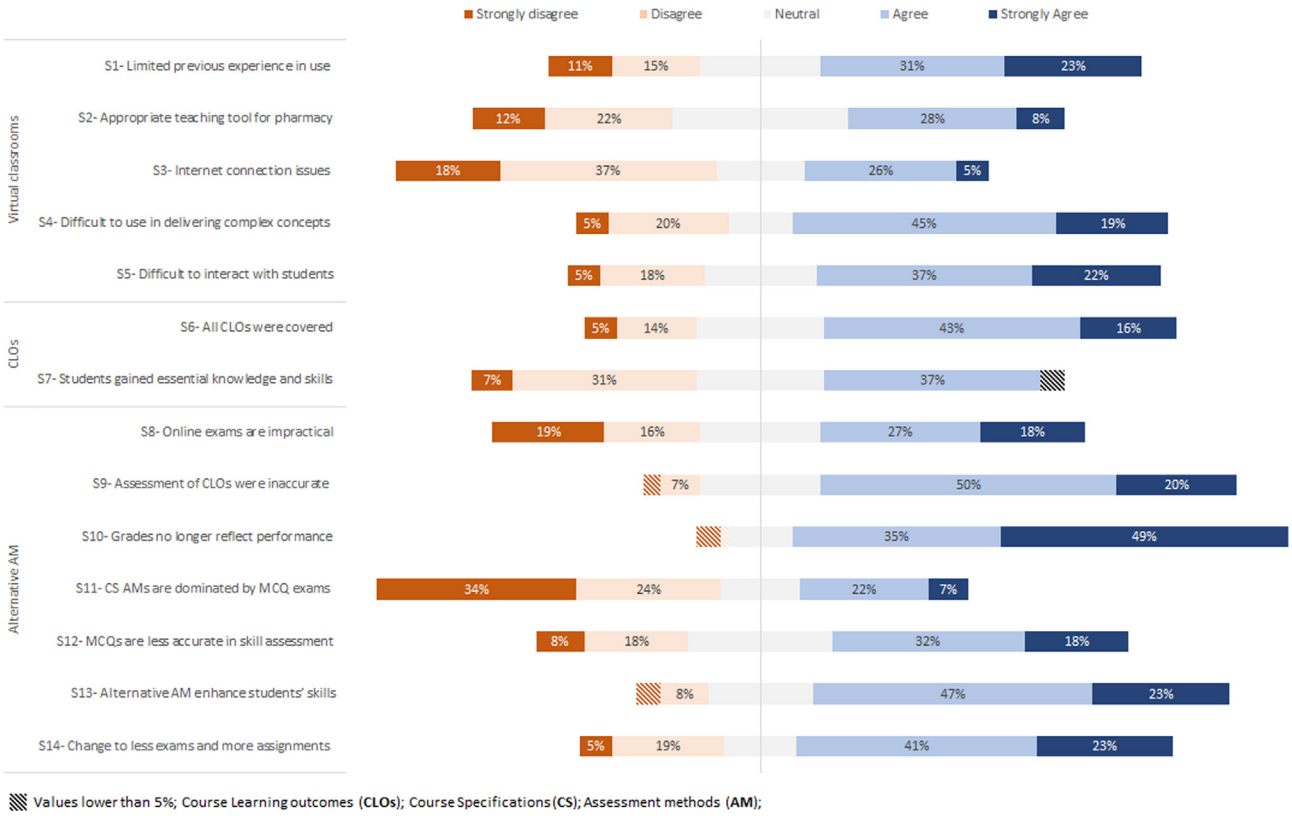

Fig. 2. Diverging stacked bar chart to show results from a 5-point Likert-scale teacher-targeted questionnaire to measure teachers' level of agreement with several statements in 3 main categories concerned with the educational process during COVID-19 lockdown, these included: Virtual classrooms, Course learning outcomes (CLOs) and Alternative assessment methods (n = 74). Full statements from the questionnaire were abbreviated above due to limited spacing. Full statements are as follows: **(S1)** Prior to the COVID-19 quarantine phase, I had very little experience in using virtual classrooms; **(S2)** After using virtual classrooms this semester, I believe it to be an appropriate teaching tool for most pharmacy related courses; **(S3)** I struggle with internet connection and thus find it difficult to stay connected to a virtual classroom; **(S4)** Explaining complex scientific concepts to students through virtual classrooms is difficult and requires more time than conventional teaching; **(S5)** Interacting with students in virtual classrooms to ensure they have understood certain concepts is difficult to achieve; **(S6)** During this phase, I believe I was able to cover all learning outcomes, except for psychomotor ones; **(S7)** Most students have gained all required knowledge and skills; their performance as pharmacists in the future will not be negatively affected by the COVID-19 quarantine phase; **(S8)** Distance learning tools, such as the Blackboard, are impractical & ineffective for exam assessments; **(S9)** Due to COVID-19 quarantine, it was very difficult to assess students' abilities and performance with regards to course learning outcomes; **(S10)** Awarded grades this semester are not an accurate reflection of students' knowledge and skills; **(S11)** Prior to COVID-19, assessment methods were mainly limited to MCQ based exams; **(S12)** MCQ exams are less accurate in the assessment of student skills; **(S13)** Introducing students to a wide range of alternative methods of assessments this semester will have a positive impact on their overall skills; **(S14)** I recommend that methods of assessment, stated in course specifications, are changed to include less exams and more assignments.

lockdown 2020 appear to have gained significantly higher marks in all courses ($p < 0.05$). Marks awarded during lockdown were densely populated in the upper part of the grading scale (80% – 100%), thus indicating less discrimination between student marks and perhaps some inaccuracy in measurement of CLOs (Fig. 3). This comes in agreement with teachers' responses as a majority (>70%) believe that assessments this semester were less accurate in measuring student attainment of CLOs, and therefore do not entirely reflect students' knowledge and skills (Fig. 2).

3.5. Training via alternative activities

Both pharmacy programs, B Pharm and Pharm D, include a training period that involves working in hospitals, community pharmacies and pharmaceutical industrial facilities. Results from the student-based questionnaire indicate that, because of the lockdown, most trainees (96.5%) (data not presented) were asked to stop attending training locations and instead were assigned alternative activities and assessments that mimic training programmes. While most students do not believe it will have a significant effect on their performance as future pharmacists, at least 26% of trainees believe that it may reduce their chances of employment in the foreseeable future (Fig. 1).

3.6. Student satisfaction

Using a 5-point scoring system, with 1 being the lowest part of the scale, students were asked to express their level of satisfaction with the performance of their college in managing educational processes during the lockdown period (Fig. 4). Results show 9 colleges (abbreviated with letters B, C, D, H, J, K, N, P and R) with majority responses ranging from 5 to 3, thus indicating a fairly good student satisfaction. Six colleges (abbreviated with letters A, E, G, L, M and O) seem to range between satisfied and unsatisfied students. Out of the 18 colleges, only 3 (abbreviated with letters F, I and Q) seem to include some very unsatisfied students. Responses for some of the colleges included a very wide range (1–5) such as the college abbreviated with the letter Q. This may indicate inconsistency in management performance, while colleges with a score range of 2 points or less may have been consistent with their performance.

Results from a coefficient analysis of non-parametric Spearman's rank correlation (Table 2) indicate that major factors negatively influencing student satisfaction include limited student – teacher interaction and perceived ambiguity in assignment instructions ($P < 0.01$). Although unrelated to university performance, statistical analysis shows internet connection problems as well as difficulty with concentrating in virtual classrooms, has lowered student satisfaction to some degree ($P < 0.01$) (Table 2).

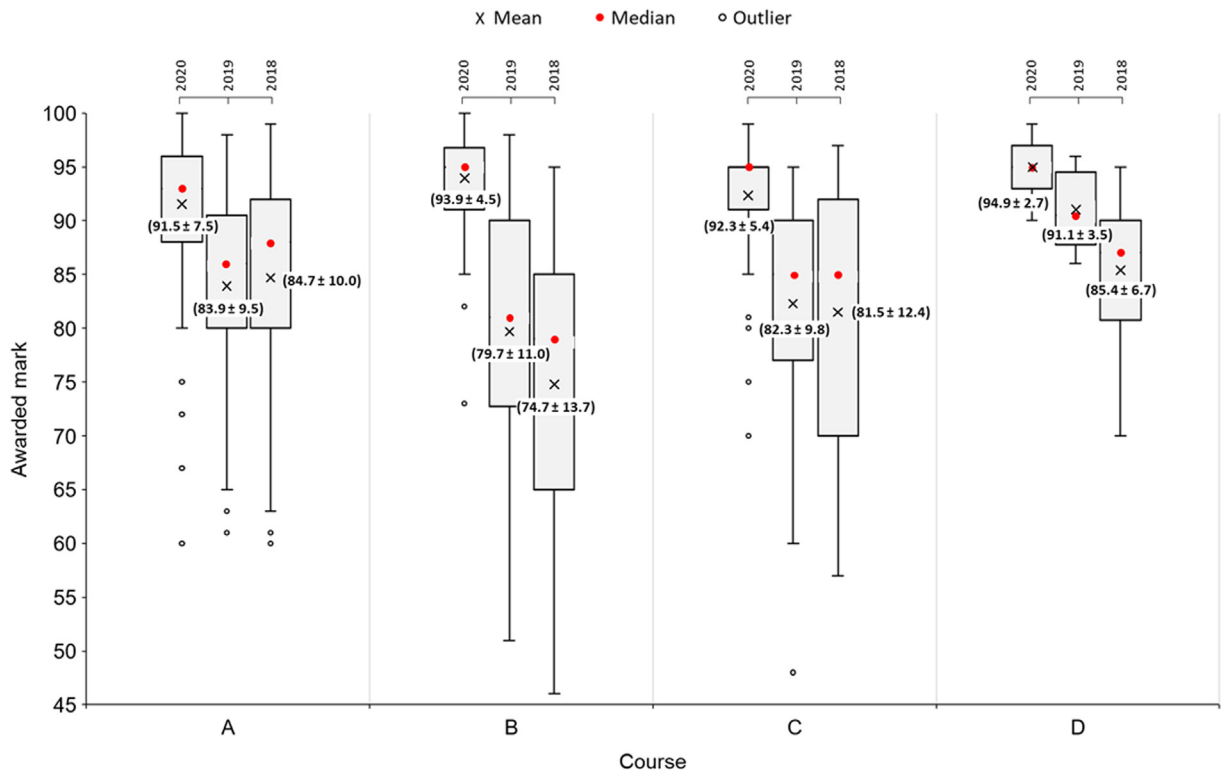

Fig. 3. Box Plot (McGill, Tukey, and Larsen 1978) comparing marks of 4 randomly chosen courses, with different pharmaceutical fields, over a period of three years (i.e. 3 cohorts of students). Awarded marks in 2020 represents assessment during the COVID-19 lockdown. The horizontal borders of each box represent the 1st and 3rd quartiles of student scores (Wickham and Stryjewski, 2011; McGill, Tukey, and Larsen, 1978). Upper and lower whiskers represent the highest and lowest awarded marks for each cohort respectively (Wickham and Stryjewski, 2011; McGill, Tukey, and Larsen, 1978). The mean ± STD ($n > 10$) values are pinned to each group. Outliers were identified using the interquartile range (IQR) rule (Schwertman, Owens, and Adnan 2004). Mean and median values are relatively close, thus indicating normal distribution (Krzywinski and Altman, 2014). Using an unpaired two-tailed unequal variance *t*-test (Kim, 2015), the 2020 student marks, for all courses, were found to be significantly different from the 2019 and 2018 cohorts ($p < 0.05$). A comparison between the 2018 and 2019 cohorts shows no significant difference in courses A and C ($p < 0.05$).

4. Discussion

The COVID-19 pandemic has forced college academics across the world to remotely teach and assess students in all levels and fields of higher education institutions. The ministry of education in Saud Arabia has supervised the transition across the country and contributed to its efficiency. The presence of a strong infrastructure for distance learning such as internet connectivity, subscriptions to various E-Systems and the readiness of experts in every institution has made it possible to continue teaching during the lockdown period. Many faculty members in health care education had limited experience with distance learning tools, however, administrative teams made a swift and extraordinary effort to train all on the basic use of software such as creating virtual classrooms and online exams on *Blackboard* and *Microsoft teams*. Although the efforts were outstanding, faculty members were short for time, as many were split between learning how to operate new technologies and teaching.

Results from this study indicate that pharmacy faculty members have gained considerable experience in the basic use of distance learning tools, yet there remain many features that can enhance that experience and perhaps help teachers and students overcome some of the observed challenges.

Both teachers and students have identified the lack of human interactions to influence their ability to remotely teach and learn, respectively. Statistical analysis has shown that the lack of interaction has been a significantly negative factor in student satisfaction. Research in education has proposed that interactions between students themselves and between students and teachers is fundamental for effective distance learning (Moore, 1989; Hunter, Deziel-Evans, and Marsh, 2003). Furthermore, contemporary education values student–student interactions considerably, as learning can be enhanced when students share their findings with each other (Hunter, Deziel-Evans, and Marsh, 2003). Embedding interpersonal skills in health education has also been known to help prepare caring, competent practitioners (Bischoff et al., 1996). This challenge may be overcome by utilizing available features in distance learning E-Systems, such as discussion forums, to help boost student–teacher and student–student interactivity. This in turn may help students engage and focus better in virtual classrooms, an issue many students have faced during the lockdown.

Adopting collaborative teaching and learning strategies can encourage group-learning and prevent learning in an isolated environment. Unlike traditional teaching, remote teaching has the advantage of technology incorporation, where various teaching strategies may easily be implemented. One of which is the "flipped classroom", where lectures may be pre-recorded and posted for students to watch at their convenience (McLaughlin et al., 2013). In place of virtual classrooms, a virtual discussion room can be utilized to accommodate students' collaborative efforts in learning. Problem-based learning (PBL), amongst student-centred teaching strategies, is another example for a suitable method to use in distance learning. Not only would it encourage exchanges, but it can also propel students to be independent learners as opposed to memorizing information of traditional lecture formats (Cyr, 1999; Camp, 1996). Published studies further showed students taught using the PBL strategy to be motivated and self-directed life-long learners, essential characters for pharmacist practitioners (Hunter, Deziel-Evans, and Marsh, 2003).

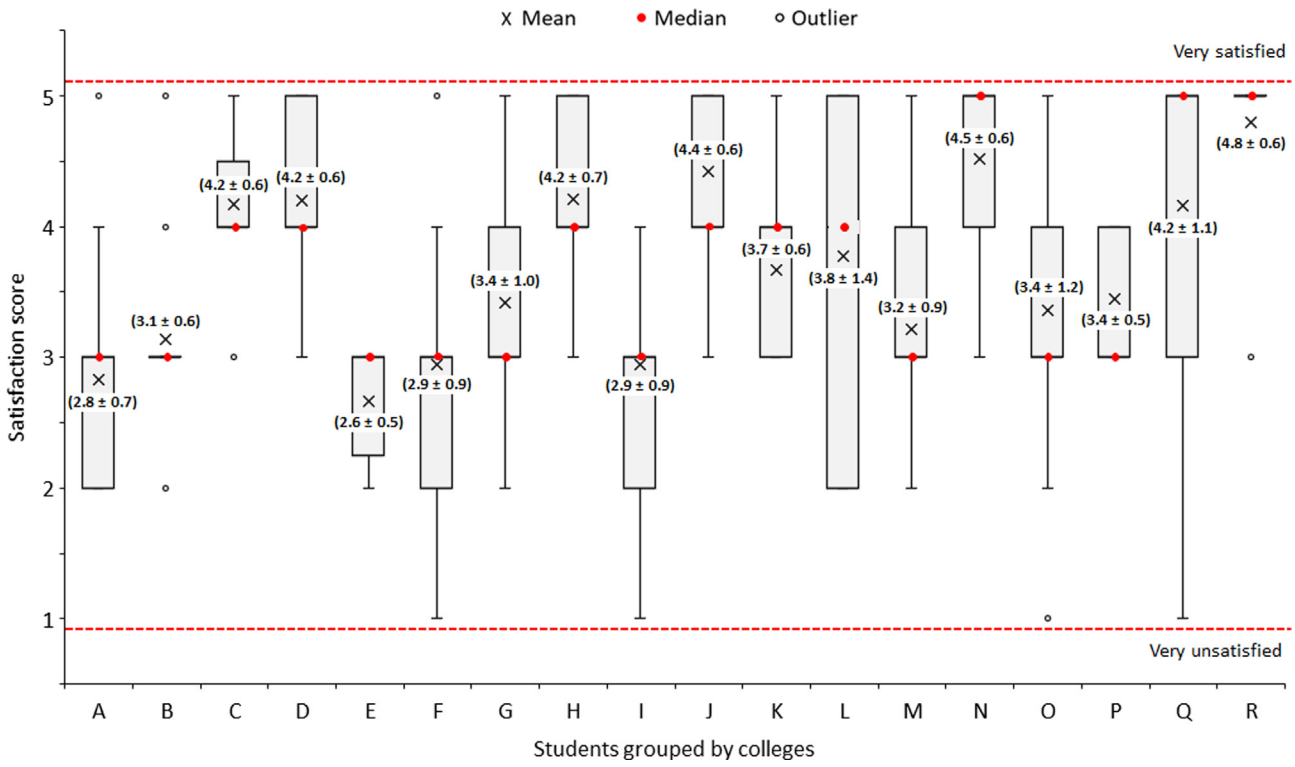

Fig. 4. Box Plot (McGill, Tukey, and Larsen, 1978) to demonstrate and compare students satisfaction, on a 5 point scoring system, with the performance of their colleges in managing educational processes, during the COVID-19 lockdown period, grouped by institution. Names of institutions were anonymously substituted for a letter to protect their privacy. The horizontal borders of each box represent the 1st and 3rd quartiles of student scores (Wickham and Stryjewski, 2011; McGill, Tukey, and Larsen, 1978). Upper and lower whiskers represent the highest and lowest values scored by each group of students, respectively (Wickham and Stryjewski, 2011; McGill, Tukey, and Larsen, 1978). The mean ± STD ($n \geq 6$) values are pinned to each group. Outliers were identified using the interquartile range (IQR) rule (Schwertman, Owens, and Adnan, 2004). For both groups, B and R, student satisfaction values were densely populated on scores 3 and 5, respectively, causing the highest and lowest scores along with the 1st and 3rd quartiles to be of the same value, therefore reducing the box and whiskers to a single line. Student groups with<6 respondents were excluded (n = 702).

Table 2
Results of a correlation analysis, using non-parametric Spearman's rank coefficient, between student satisfaction with the college performance in managing educational processes during the COVID-19 lockdown period, and responses to questions from Fig. 1. Spearman's rank correlation coefficient was used in this instance as the output of Likert-scale questionnaire is of ordinal data. (n = 363).

Variable	Correlation with student satisfaction	
	P value	Correlation coefficient
Virtual classrooms		
Internet connection issues	< 0.01	−1.24
Limited interactions during lectures	< 0.01	−0.24
Difficult to concentrate during virtual classrooms	< 0.01	−1.99
Assessment		
Too many assignments and not enough time	> 0.01	−0.73
Assignment instructions were unclear	< 0.01	−1.61

The most challenging part of conducting distance education during the lockdown has been the remote assessment. Although many distance learning systems provide platforms for online exams, teachers have a negative perception as students are not under monitoring and thus may be able to cheat (Kaczmarczyk, 2011). Furthermore, the use of distance learning tools for online exams required learning more about the formatting needed, which can be complex. Many teachers have resorted to alternative assessment methods, this included written assignments, where students were asked to write a report or an essay through which a demonstration of attaining a learning outcome is measured. Results from this study, however, shows that many students had difficulties understanding the required action. While in many cases, written instructions where provided to students, the lack of experience in dealing with such assignments has left students frustrated. To add to this, the concept of plagiarism is new to many, as a result, students have struggled to write in their own words. Results from this study also show that perceived ambiguity in assignment instructions has been one of the significant factors in influencing student satisfaction ($P < 0.01$). Interviews with students and teachers have revealed the feeling of unfairness many students share. Despite this, analysis of student grades, during the lockdown, has revealed a significant increase when compared to the past two years. Although only four courses were investigated, this was further confirmed by all interviewed academics.

Regardless of struggles, the majority of teachers believe that alternative assessment methods will have a positive impact on students' overall skills. Thus, many support changing plans of assessment methods, stated in course specifications, for post-lockdown teaching. While exams are an excellent tool of a summative assessment, these alternates may be more suited for ongoing formative assessments. Traditionally, a greater percentage of the total course mark is dedicated to exams and only a small fraction ($\approx$ 10%) is reserved to alternative assessments. While this may reduce the workload on academics, and especially if exams are of MCQ nature, student attainment of various CLOs based skills are not accurately measured. This includes cognitive, interpersonal, time-management, communication, and information technology skills. In many cases, such skills contribute to half the CLOs while only 10% of the course marks were conventionally used to assess them under the ambiguous category of "activity". This has indirectly guided students to focus on memorizing lecture materials and ignore other sources of information.

While exams may be used to assess knowledge and cognitive skills, the process of building ones knowledge through research, interpretation, analysis and evaluation followed by sharing his or her findings through a concise well-written document or an engaging presentation, can stimulate critical thinking and collaborative learning. Where teachers can not only act as information providers but also help as modulators and facilitators.

Integrating alternative methods of assessment and collaborative student-centred teaching strategies may be the responsibility of teachers and program management teams. Pharmacy students must also be encouraged to adopt a proactive learning strategy, where complete dependence on teachers for information is discouraged. Although some students may have unrealistic expectations of the need to be "spoon-fed" information and be awarded full marks simply by regurgitating the information back in an exam, it is the teacher's responsibility to push students towards taking responsibility for their own learning. An emphasis should be placed on testing the depth of student comprehension of critical CLOs.

Teaching remotely during the lockdown period was an excellent opportunity to revise teaching strategies and assessment methods used in normal circumstances. This study does not only encourage a contingency plan for emergency remote teaching, but also for a change in the everyday educational process that can positively impact teacher and student performance in all learning settings.

In addition to taught students, this study investigated the impact COVID-19 lockdown had on pharmacy trainees. Most colleges have pulled back their students, in fear for their safety, for approximately half a term. For this period, trainees were offered alternative online activities. While this period may represent a small portion of the Pharm D training duration, it represents approximately a quarter of the B Pharm training duration. Majority of graduates believe this will not have a negative impact on their practice as pharmacists. However, a small proportion ($\approx$ 26%) of graduates are concerned by the limited interactions they have had with employers in the pharmaceutical industry, and thus fear a lower chance of employment in the foreseeable future. Furthermore, the impact of lockdown on employment rates in the pharmaceutical industry is still unknown.

4.1. Recommendations and discussion points

4.1.1. Colleges and program management teams

1. Recommendation to address incompletion of CLOs during the lockdown period:

This study shows that during the lockdown period, several CLOs have not been completely covered, especially psychomotor based ones. In addition, many teachers believe that students have not been able to attain all essential knowledge and skills to cover all basis. Both teachers and students have expressed interest in holding revision sessions in the upcoming year, program management teams are encouraged to design and schedule a number of temporary short courses to mend this issue.

2. Recommendation to address graduates fear of unemployment

Employment rates of graduates is a program key performance indicator and must be monitored for NCAAA program accreditation. Nevertheless, alumni committees must increase their efforts in guiding fresh graduates seeking employment.

3. Recommendation for developing a contingency strategy for emergency remote teaching:

Although pandemics are thankfully rare, other situations may also call for emergency remote teaching, another recent example for Saudi Arabia is the impact of the Gulf war (1990–1991) on educational institutions. While recorded news of school and university closures are available, limited research was performed on the impact of the war on education as well as future plans to adapt with similar circumstances. To avoid missing such opportunity, and in preparation for a possible lockdown extension, the author encourages educational program management teams across the country to explore the possibility of putting in place a contingency strategy for emergency teaching. This may include:

- Creating a Contingency Course Specification (CCS), a short document that outlines appropriate student-oriented teaching strategies and assessment methods to be used for each CLO in crises times.
- CCS may also be used to define CLOs that may be successfully completed under lockdown circumstances, while outlining a plan for the completion of other learning outcomes post-lockdown. For example, such CLOs may be incorporated into related courses or made into a short compulsory course.
- Creating an overall timeline map of all required assessments to be completed by students from each level or program year, thus, to help coordinate coursework between different courses and to ensure sufficient time is given for completion without overloading students.
- To further investigate attainment of program learning outcomes, an additional post-lockdown traditional assessment may be utilized. Analysis from such assessment may be used to design short comprehensive summer courses to further correct student deviation from the program plan.

Long term recommendations to enhance the efficiency of contingency strategy may include:

- Further improving the infrastructure for distance learning, based on stakeholders' experiences during the lockdown period.
- Providing training and technical support to all faculty members in effective use of distance educational tools for student-oriented teaching and assessment strategies. This may come in the form of a compulsory online course in alignment with preparing new PhD graduates to teach at university level.
- Integrating available Learning Management Systems (LMS) into the normal routine of daily teaching and assessment process. This will facilitate a better digital environment for student–teacher and student–student interactivity, as opposed to using emails and phone-based communications. While this will help monitor in-process quality of education, it will also allow for data collection and thus research and development of education.
- To better equip final year students for pre-registrational training under special circumstances, program managements are encouraged to introduce compulsory requirements of volunteer training hours for students of senior levels.

4.1.2. Board of deans for the colleges of pharmacy in KSA

4.1.2.1. Recommendation for collaborative initiatives:. Education based collaborations between colleges of pharmacy in Saudi Arabia are still developing. A great initiative of collaboration has started after the formation of a board of deans for pharmacy colleges in Saudi Arabia. This had a positive impact on the standardisation of goals for pharmacy programs. Nevertheless, a greater interaction is needed between pharmacy colleges to further push pharmacy education forward to maintain a high calibre of pharmacy gradu-

ates. Therefore, the author recommends the formation of a broader organisation such as "*Saudi association of colleges of pharmacy*" (SACP). This may also further quality of teaching and research efforts as well help to absorb the impact of crises.

6. Conclusions

The COVID-19 pandemic had a significant impact on pharmaceutical education in Saudi Arabia. While all teaching processes were forced to be distant, the ministry of education has led educational institutions across the country to a successful completion of the semester. This extraordinary situation called for a study to investigate student satisfaction with the emergency education processes conducted during this time. The use of online virtual classrooms, as a substitute for face-to-face traditional teaching, came with its challenges. The most significant was the limitations of student–student and student–teacher interactions. To overcome this challenge, the author recommends the implementation of various student-centred teaching strategies where proactive learning is encouraged. Assessment via alternative methods during the lockdown has alerted teachers to the importance of their use in normal circumstances, as they can have a positive effect on students CLO based skills. Nevertheless, as students have less experience in working with alternative assessment methods, it is important they are accompanied by a student friendly guide to help them better understand the required actions and the marking scheme.

Declaration of competing interest

The author of this study declares no competing financial interests or personal relationships that may have influenced the study performed in this paper.

Acknowledgements

The author would like to thank the College of pharmacy at Taibah University (Al Madinah Al Munawarah, KSA) represented by Prof. Saleh Bahashwan the college dean, and the Vice Deanery for educational affairs represented by Dr. Sultan S. Althagfan the Vice dean for Academic Affairs.

The author is very grateful to the recently graduated pharmacist Azzam Alghamdi and the undergraduate pharmacy students Mr. Muhanad Algamdi and Mr. Ahmad Haidar Al-Hrazi for participating in the student interviews. The author is also thankful to Dr. Sultan Althagfan Prof. Khairy Gabr, Dr. Ahmed Effat and Dr. Rawan Saeed Bafail for taking part in the teachers' interviews.

The author is also very thankful to Dr. Fatma Al Qudsi, Mrs. Somaiah Alqurashi, Mr. Ibrahim Alqurashi, Mis. Abrar Alqurashi and Mr. Yahya Alqurashi for their early contributions in developing the questionnaire of this study.

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