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Contemporary pharmacology teaching methods in the Covid-19 era at Umm Al-Qura University

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Abstract

Globally, Covid-19 has created unparalleled challenges at all levels of education. In view of this, Umm Al-Qura University (UQU) introduced electronic learning in education as a measure to limit the pandemic's effects. In this study, a comparative, cross-sectional approach was taken to explore the use of electronic learning as an active teaching model. The Blackboard was utilized to aid knowledge retention and transform pharmacological knowledge from theoretical to practical knowledge. The study was conducted between January 2020 and April 2021 with 415 pharmacy students. Students felt that content saturation and traditional lectures were critical obstacles for active teaching. Meanwhile, integrated active intellectual teaching methods, including flipped classrooms and practical video simulations, facilitated students' engagement. As contemporary teaching methods are required in modern education, UQU has sought to empower excellence in education and transform the teaching of pharmacology during the pandemic.

Keywords: *Pharmacology; contemporary teaching; instructional strategies; electronic learning; Blackboard; Covid-19.*

1. Introduction

Effectively implementing innovative technology in the field of classical education is a modern day challenge. However, this is important because new educational models that use electronic learning (e-learning) can develop skills and competencies, as well as enhance student engagement and promote interactive learning (Brouwers, Makarski, and Levinson, 2010). Existing research on information technology shows that the acquisition of knowledge is linked to technical developments that pass on information (e.g. multimedia technologies). Thus, incorporating such methods in education facilitates the shift from externally controlled to self-directed learning (Hutten, Stiegmaier, and Rauchegger, 2020). Given this background, educational institutions are faced with the question of how to best incorporate technology into their course design.

This existing challenge was further complicated by the Covid-19 pandemic, which created challenges at all levels of education (Hoofman and Secord, 2021). When the pandemic began in 2020, the Saudi government announced that all education would continue on a remote basis (News, 2020), which forced educational institutions to rapidly shift their teaching methods. The aim of this study is to explore the uses of e-learning as a contemporary teaching model and to analyze the barriers and strategies associated with its adoption. To this end, one such institution, the Saudi Umm Al-Qura University (UQU), will be taken as a case study.

2. Method

2.1. Ethical considerations and study design

The study was approved by the Scientific Research Ethics Committee at UQU (Institutional Review Board number: HAPO-02-K-012-2022-02-972). A comparative cross-sectional approach was used to examine the use of e-learning as an active teaching model. Participants were undergraduate (second-, third-, and fourth-year) Doctor of Pharmacy students that were registered at UQU pharmacy college. Participants were provided an informed consent form that they signed prior to taking part in the study.

2.2. Pharmacology course design

During the pandemic, the pharmacology curriculum was adapted into an online teaching course made up of four modules: pharma I (drug neuropharmacology, including effects at the cellular and molecular level on the central and peripheral nervous system); pharma II (cardiovascular pharmacology of drugs used in the treatment of cardiovascular diseases); pharma III (basic and clinical toxicology, including the effects of drug toxicity on experimental and clinical levels); and pharma IV (oncological pharmacotherapy, which are drugs that slow or block cell growth and are most often associated with cancer; and antimicrobial pharmacology, which are drugs used to treat bacterial diseases). Each module

contained 12 chapters. To ensure that the students concentrated on their studies, the teaching content in each chapter was divided into several theoretical and practical classes lasting approximately 60–90 minutes each. This structure addressed the course's intended learning outcomes (ILOs) (knowledge, skills, and values), with the aim of guiding students through active high-impact teaching.

2.3. Contemporary teaching strategies

Several creative teaching approaches were employed to teach the pharmacology course on a remote basis. The aim of these strategies was to take the online course from a low-impact traditional level (that of teacher-centered "teach in front of a computer screen" and student-centered "stay at home and take the course passively online") to a high-impact modern level by applying integrated methods of active intellectual teaching. These integrated teaching strategies included taking a pharmacotherapeutic approach by drug class and sub-class; problem-based learning case studies; practical video simulations; flipped classrooms; and gamification in pharmacology science group activities.

2.4. Contemporary assessment strategies

To assess the effectiveness of pharmacology teaching as an educational outcome, various questions were posed by UQU faculty members at the end of each module. These questions evaluated different pharmacological teaching methods, while also focusing on the students' interests and knowledge during each theoretical class. Five kinds of questions were posed: open-ended (questions that promoted student interactive discussion); closed-ended (questions used to focus thinking on a particular pharmacological drug interaction); rhetorical (questions that reinforced a therapeutic idea or emphasized a point); managerial (Blackboard polling questions that kept the pharmacology classroom operations moving); and essay questions (asking for pharmacological information, such as descriptive, evaluative, and comparative points of view).

2.5. Study survey

The survey, which was adapted from a questionnaire used to get students' feedback at the end of each semester, was hosted by the UQU WebEx research platform. Participants were given summary evidence of e-learning's impact on education, and they used a four-point Likert scale to address the following: their satisfaction with UQU's integration of knowledge management and e-learning; the most concerning learning barriers; and the best strategies to mitigate said barriers. The study followed the Checklist for Standards for Quality Improvement Reporting Excellence for Education (Greg *et al.*, 2019).

2.6. Statistical analysis

Descriptive statistics were used to summarize the responses. For categorical variables, responses to "Yes/No" or multiple-choice questions were calculated using numbers (n [%]). Regression models were used to explore the relationship between demographic factors and responses using t-tests, mean differences of continuous data, and chi-square tests for dichotomous or ordinal data. A two-side hypothesis testing was then carried out at the 5% significance level. The Blackboard and Webex research platforms were used to produce graphical outputs and perform statistical analyses.

3. Result

The study was conducted between January 2020 and April 2021. Four hundred and fifteen undergraduate pharmacy students participated with a total of eight groups in each academic year (four female and four male subgroups, ranging from 15 to 17 students each). The length of each pharmacology module was 16 weeks (12 academic weeks and 4 examinations). Six high-impact instructional strategies were identified: the strategy of high relevance, high-quality engagement, effective assessment, effective feedback, adequate support, and the preparation of contingency plans. They are presented below to emphasize how instructors used e-learning technology to improve pharmacology teaching experiences.

3.1. High relevance between e-learning instructional plan design and student education

The Blackboard was used as a comprehensive digital learning tool. Its Collaborate Ally function elaborated the course's lesson plan design seamlessly, thereby bridging the gap between theoretical and practical classes. This helped the faculty to take control of the digital course contents and make ILOs more accessible to students in an integrated way. The Blackboard's Collaborate Synchronous function was also used to engage students and encourage the development of professional skills.

3.2. E-learning and high-quality engagement

The Blackboard, Mediasite, and WebEx platforms were used to facilitate collaborative and group activities. The Blackboard Analytics was utilized to support pharmacology knowledge retention. While the Mediasite was used to deliver practical videos to simulate active teaching, WebEx was used for asynchronous and synchronous communication (web-audio-video meetings on how to do scientific pharmacology presentations using flipped classrooms etc.). In this way, the platforms offered a well-rounded learning experience by ensuring that all enrolled students could realize their potential and actively collaborate during their classes.

3.3. E-learning and effective assessment of student education

The Blackboard was regularly adjusted to ask various types of questions at the end of each pharmacology module chapter to assess teaching and learning outcomes. Its assessment and accreditation functions helped the lecturers simplify assessments and improve problem-based learning and flipped classrooms (in contrast to traditional lectures, which are often perceived by students as being boring and dry). The average percentage difference of students per activity interactions was 85%; course rating, activity assessment, and access to pharma II module contents were highly valued at 100%. Figures 1 and 2 detail the course activities of one student, who spent the most time studying the course contents (more than 50 hours, which was above the course average of 10% of the grade center scores in the pharma II module).

3.4. E-learning and adequate study support provided by UQU faculty

The students' weekly marks and feedback reports allowed the UQU faculty to intervene early and keep them on track for success. Furthermore, the Blackboard helped staff predict and identify at-risk students and therefore eliminate their achievement gaps, making it possible to overcome learning and progress barriers. The module activities grade matrix identified active students with the highest grade interactions (i.e. those who scored an A^{+}, 100-95, or an A, 94-90), as well as inactive students with the lowest grades (those who scored a B, which less than 80%), as shown in Figure 3.

The linear regression model explained 3.1% of the variance in students' scores, which was statistically significant at α=0.05. The scores were positively associated with their accessibility to pharmacology courses such that, for each additional accessibility to the course activities, the natural log of accessibility was predicted to increase by 0.002 units; this association was statistically significant (P = 0.001) with more than 85% of the grading scores (Figure 4).

3.5. E-learning and effective feedback of UQU students

The survey findings show that e-learning deepened knowledge and skills in experimental operations that used a cumulative e-learning based assessment (Figure 5). Overall, 333 (80.2%) students were satisfied with the integration of pharmacological knowledge management and e-learning, and only 102 (24.5%) were dissatisfied with the lack of practical pharmacological classes involving animals. Additionally, 232 responders (55.9%) and 183 responders (44.1%) rated traditional courses and content saturations as being important barriers to active teaching, respectively. Conversely, 224 responders (54.0%), 150 responders (36.1%), and 140 responders (33.7%) rated the therapeutic teaching strategies by drug classes, practical video simulation, problem-based learning case studies, and flipped classrooms as important innovative strategies to overcome passive teaching, respectively.

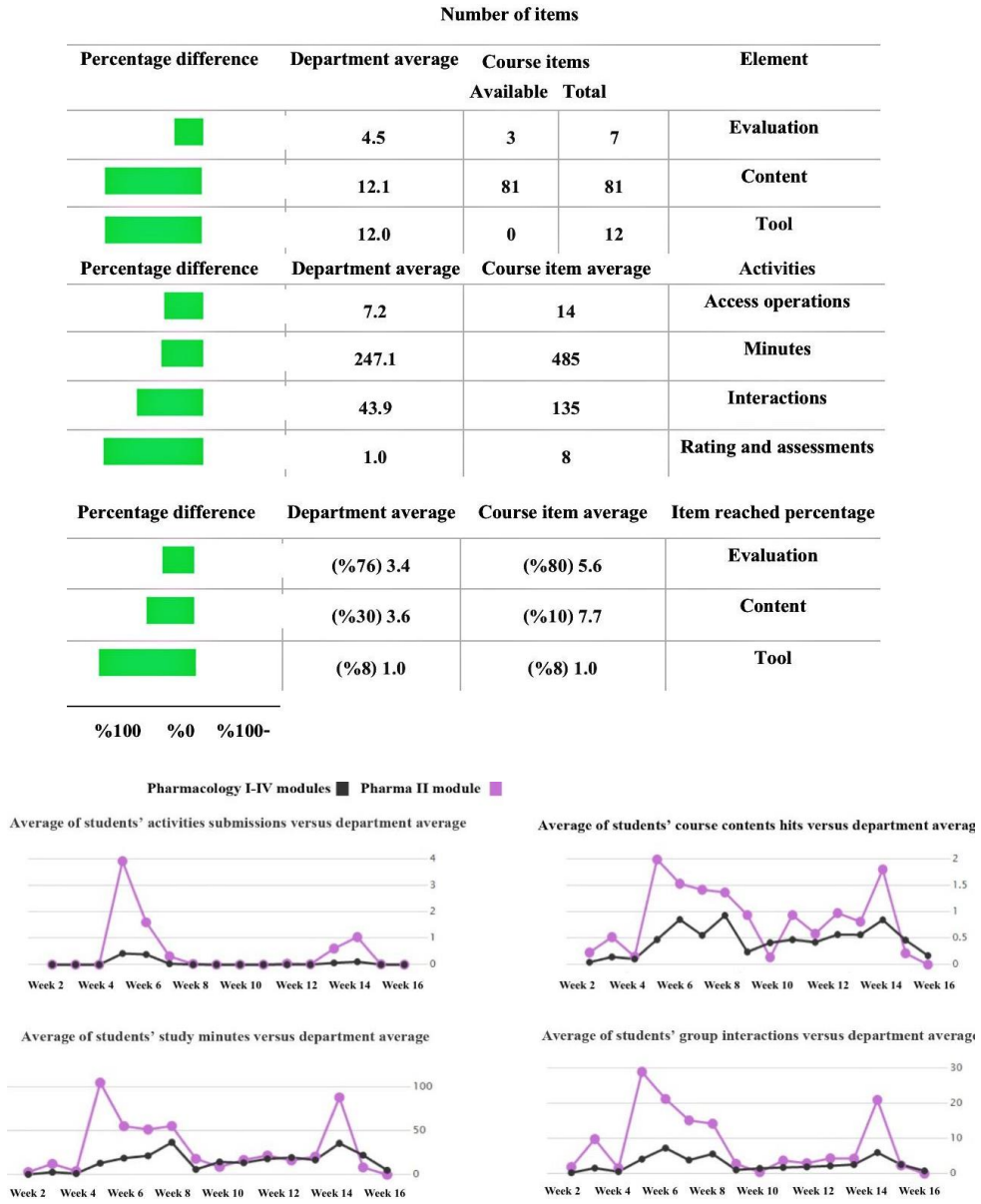

Figure 1. The course activities and assessments overview for pharma II module versus all pharma modules (I-IV).

Figure 2. The course activities and assessments overview per student in pharma II module versus all pharma modules (I-IV) with the highest marks

3.6. Contingency plan to manage unexpected technical obstacles to e-learning

Due to the sudden emergence of Covid-19 and the subsequent shift to remote learning, most UQU faculty members and students faced the challenge of overcoming poor e-learning management experience. To enable this, UQU launched a digital library for training and an online forum to teach faculty and students how to use e-learning programs. Furthermore, UQU technology support teams from the Deanship of E-learning and Distance Education (from the University Vice Presidency for Educational Affairs) offered regular courses to support UQU faculty and students (UQU, 2020).

4. Discussion and Conclusion

Pharmacology teaching is in a state of constant reform. This is especially important in the Covid-19 era, where education faced new challenges. In the interest of promoting UQU in international university rankings, university officials made an effort to empower its students, transform the teaching of pharmacology, and apply integrated methods of teaching. The initial implementation of e-learning using the Blackboard was highly successful and time-efficient during the pandemic. This study recommend six instructional strategies for high-impact teaching practice in pharmacology to ensure that pharmacy students effectively engage and collaborate in the transition to high-impact education.

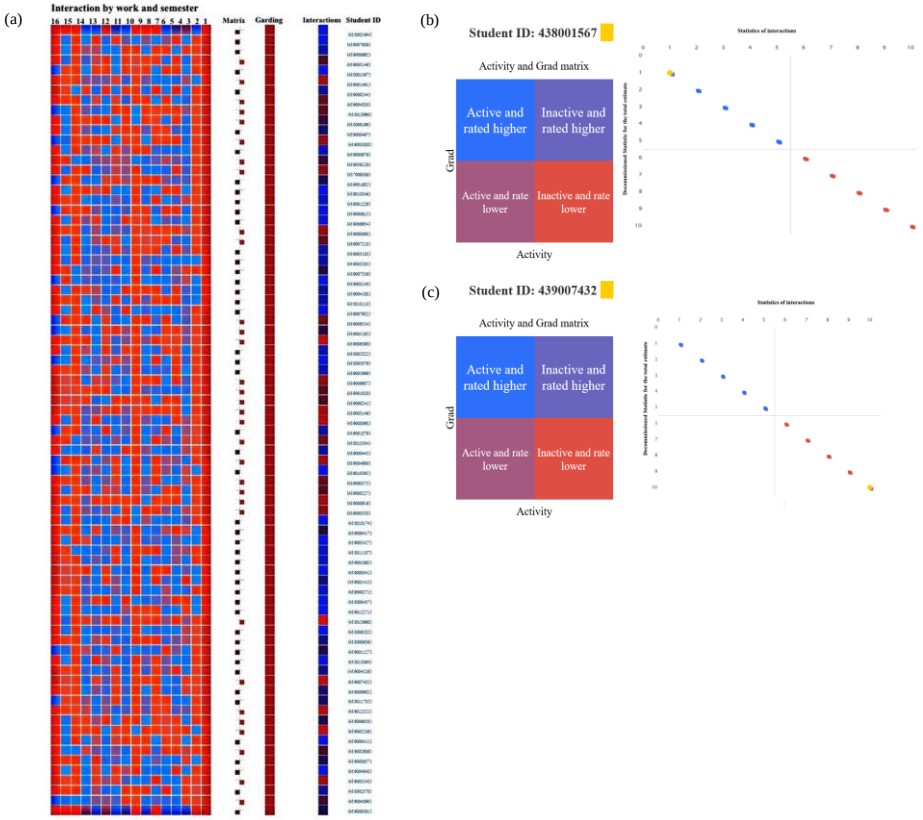

Figure 3. (a) Module activities grade matrix of students enrolled to pharma II course. (b) Grade matrix of active student with A^+ and A highest grade. (c) Grade matrix of inactive student with lowest grade less than B grade.

This was evidenced by pharmacy students' formal feedback on the effectiveness and efficiency of the desired ILOs for this structural course. However, the majority of pharmacy students considered the lack of active practical involvement and spending more time in-class (compared with practical studying outside the classroom) to be important barriers, which may affect their learning effectiveness. Based on this, it appears that students' challenges did not come from technical obstacles, but from difficulties such as their own learning attitude, which may include a lack of self-discipline or a good learning environment at home. Therefore, the quantity, difficulty, speed of learning, and length of teaching content should match the academic readiness and online learning behaviour of students. Constructivist didactics try to optimize individuals' acquisition of knowledge by fostering active thinking and providing an optimal learning environment. Cognitivist theory advocates acquiring a balance between self-directed (student-centred) and externally directed (teacher-centred) instructions (Berzbach,

2004). For this purpose, this study utilized e-learning in education with a development of social competences that fostered learning in small groups. The use of contemporary teaching strategies such as high-quality engagement (learning with peers in small groups using asynchronous or synchronous communication), cognitivist didactics (evidence-based learning, practical video simulations, and personal interpretations), effective assessment, and supportive feedback, ameliorates pharmacy students' experiences. Such strategies help pharmacy students develop their own effective learning strategies, including critical thinking and problem-solving. Hence, gaining knowledge is not an external process (as in cognitive science), but is internally driven (self-directed learning).

Although the results of using e-learning in pharmacology are promising, there are still unresolved questions including how to measure the success of e-learning in the short- and long-term. If one accepts that constructivist learning is best suited for e-learning, a conceptual problem arises, since traditional examinations have a strong basis in cognitive learning theory. To address this, pharmacologists and pharmacists must collaborate with educational professionals to develop suitable modes of evaluation.

Model	B	Std. Error	Beta	*t*-test	Sig.	95% confidence interval for B (upper – lower bound)
Constant	5.189	0.040		129.516	0.000	5.110 – 5.268
Accessibility	0.002	0.001	0.163	3.112	0.001	0.001 – 0.004

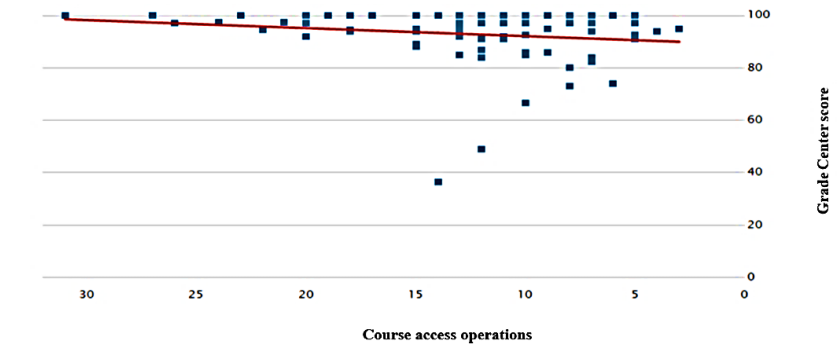

Figure 4. The grading distributions and access to pharma II course module versus all pharma modules (I-IV)

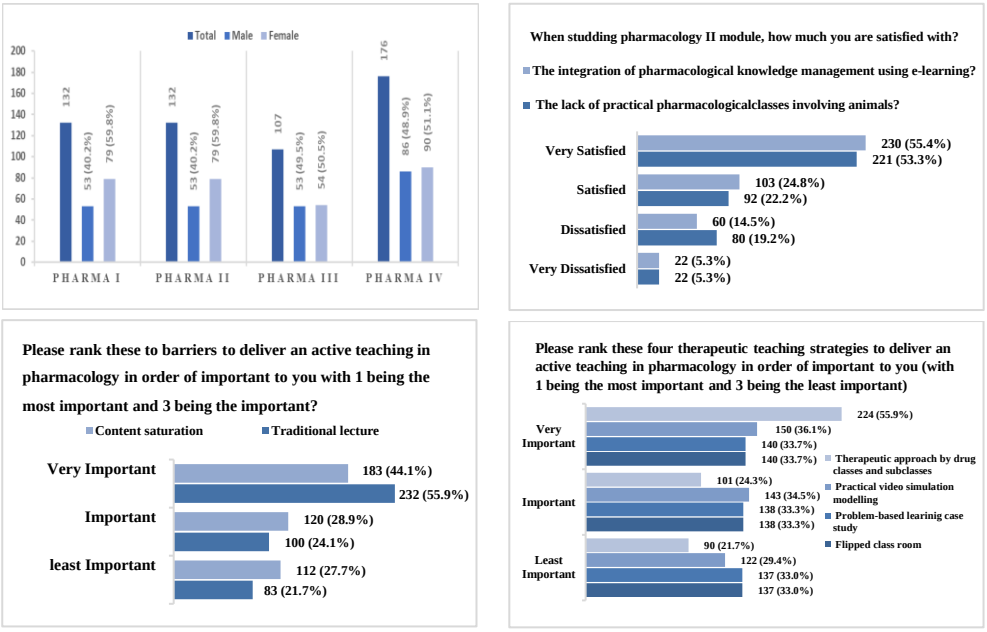

Figure 5. Participants survey results of pharma modules (I-IV)

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