ORIGINAL ARTICLE

E-Learning in Pharmacology Education During COVID 19 Pandemic: Students' Preference & Perception of Assessments

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ABSTRACT

Introduction: Pharmacology is one of the fundamental components of the undergraduate pharmacy curriculum, providing core knowledge on the mechanisms of drug action and toxicity, consequently laying the foundational concepts in rational pharmacotherapeutic decisions. The Covid-19 pandemic has urgently forced educational institutions to transition to online remote learning. This unprecedented move has not only affected teaching and learning, but also assessments, a known factor in driving student learning. This study served to determine students' preference and perceptions of the assessments utilised for pharmacology courses in the undergraduate pharmacy programme, during the online and distance learning period. **Methods:** An online survey questionnaire was developed and distributed to students enrolled in the Bachelor of Pharmacy (B. Pharm) programme at the Faculty of Pharmacy, UiTM Selangor Puncak Alam Campus. Three hundred and fourteen students participated in the study. Collected data was then analysed using SPSS version 26. **Results:** Findings revealed that the majority of students preferred multiple choice questions (MCQs) test the most. Problem-based learning (PBL) was also among the most favoured especially among 3rd year students. In term of perceptions, this study disclosed that students acknowledged all assessments conducted for pharmacology courses contributed to their understanding towards course material, knowledge strength, analytical and critical thinking skills, problem analysis and learning feedback. **Conclusion:** Although the findings were mostly positive, a more thorough investigation is needed to identify how these assessments can be improved. Regular review on how curriculums are delivered and assessed are imperative in order to implement necessary measures for improving learning outcomes.
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INTRODUCTION

Assessment is an essential part of teaching and learning. It serves as an evaluation process to determine learner's achievement. In assessment, the standard is a success metric that distinguishes those who perform well enough from those who do not (1). Through an appropriate assessment, students can develop and enhance their analytical, critical, and problem-solving skills whenever they confront future work challenges.

Generally, both formative and summative assessments types of assessment are utilised in the Bachelor of Pharmacy (B.Pharm) programme at the Faculty of Pharmacy, Universiti Teknologi Mara (UiTM). Both types of assessment have significant purposes. Formative assessment measures how well students grasp course content through weekly quizzes, in-class discussions, and homework assignments (2,3). On the other hand, summative assessment summarises students learning after gaining some inputs at the end of a unit, such as standardized test, final assessment and final project (3,4). Assessment in higher education is vital in providing students with a quality education and competency after graduation (5).

In the past year, the education system has dramatically changed due to Covid-19. The pandemic forced the diversion of face-to-face learning to online platforms in order to ensure the safety of students, instructors and other academic staffs. Like other universities throughout the Malaysia, the B.Pharm programme at UiTM was also impacted by the change, resulting in adoption of e-learning (6). The changes in terms of teaching and learning, including assessment were based on the circulars and guidelines from the Academic Office, UiTM, Malaysia Qualification Agency (MQA), Malaysia Pharmacy Board (MPB) and Vice Chancellor Office of UiTM. A revised curriculum to suit the open distance learning (ODL) delivery was endorsed at the faculty level and subsequently submitted for approval to MPB via MQA.

One of the biggest challenges in e-learning has been the shift to online assessment. Prior to COVID-19, a large bulk of graded assessment for most subjects taught in the B.Pharm curriculum is the final examination whereupon students are required to answer combined objectives and essay questions. Aside from that, a smaller proportion of the graded assessments would usually consist of quizzes, lab practical reports, problem-based learning (PBL) or case-based learning (CBL) written assignments. Remote learning and assessments were not the norm then. Social distancing requirements mean that most traditional ways of testing (i.e., exam halls for knowledge tests, Objective Structured Clinical Examinations (OSCEs) for practical skills) are no longer feasible.

Consequently, the shift to remote learning necessitates the need to redesign the assessments that would suit an online platform. Designing an appropriate assessment strategy over that short time period was and still is a challenge for the course instructors, especially in ensuring that assessment structure is well aligned with intended learning outcomes. While there are guides on online assessment best practices as useful reference points, not all practices would be applicable or useful to the current situation and/ or the B.Pharm curriculum. There are multiple drawbacks in substituting in-person examination to online/ virtual assessments, including difficulties in assessing practical skills and concerns of disparity of students' access to reliable internet connectivity, as well the reliability of security system in safeguarding integrity of online assessments (7).

In order to ensure quality educational delivery, a continuous evaluation of the implemented assessments needs to be done. Over the last decade, research into student's assessment preference and perception has gained traction due to increase in understanding of factors that drive learning process and its outcomes. An assessment is one of the defining features of students' approaches to learning. Students' perceptions of the assigned learning assessment, based on previous and current learning experiences, have been shown to affect their learning strategies and, as a result, the consistency of their learning outcomes in studies (8,9). To achieve successful results, students must have a positive perception of their assessment.

For undergraduate pharmacy students, pharmacology courses are fundamental, must-enrol subjects. Pharmacology provides students with essential basic knowledge to decide on rational pharmacotherapeutic management later on in their career as a pharmacist (10). As it is a critical subject of the B.Pharm curriculum, it is all the more important to gain some form of feedback with regards to the online assessments implemented throughout the pandemic period.

This study aimed to evaluate preference and assess perceptions of usefulness of online assessments utilised in the pharmacology modules during COVID 19 andemic among students enrolled in the undergraduate pharmacy programme at the Faculty of Pharmacy, UiTM Puncak Alam Campus. Examining students' perceptions of assessment would encourage the development of better assessment approaches. Additionally, it would help educators in developing effective educational programme that promotes deep learning.

MATERIALS AND METHODS

Research setting

This was a descriptive cross-sectional study conducted among students enrolled in the Bachelor of Pharmacy (B. Pharm) programme at the Faculty of Pharmacy at UiTM Selangor, Puncak Alam Campus. Five hundred and twenty-six students enrolled in various pharmacology courses across all study years in semester 2 of 2020/2021 were recruited as respondents in this study. In general, all pharmacology courses consist of 4 types of summative assessments. The bulk of the graded summative assessment marks were made up of Test 1 (consisting of multiple-choice questions) and Final Assessment (consisting of open-book structured essays). Other modes of assessment utilised in pharmacology courses include structured written assignments, and practical/ CBL/ PBL/ computer-aided learning (CAL) reports respectively. The different pharmacology course offered in each study year and the types of assessment utilised as shown in Table I.

Research methodology

An online questionnaire was disseminated among these students to assess their preferences and perceptions of the various assessment method used. The questionnaire was self-developed based on recently used summative assessment methods, and consisted of 31 items pertaining to sociodemographic information, students' preference of assessment method utilised and perceptions of the usefulness of assessments based. Questions ranged from open-ended, multiple-choice and Likert scale forms. The five ratings on Likert Scale were strongly agree, agree,

Table I: Pharmacology courses and types of assessment for each study year

Year of study	Pharmacology courses	Assessments			
		1	**2**	**3**	**4**
2	Peripheral Nervous System Pharmacology	Test 1 (MCQ)	PBL	written assignment	Final assessment (open-book structured essays and short answer questions)
3	Respiratory & Renal System Pharmacology	Test 1 (MCQ)	PBL	CAL	Final assessment (open-book structured essays and short answer questions)
	Cardiovascular System Pharmacology	Test 1 (MCQ)	PBL	practical report	Final assessment (open-book structured essays and short answer questions)
4	Cancer Chemotherapeutics	Test 1 (MCQ)	PBL	CBL	Final assessment (open-book structured essays and short answer questions)

neutral, disagree and strongly disagree. The questionnaire was reviewed by five senior pharmacology lecturers to ensure that each item was relevant and suitable.

Prior to actual data collection, a pilot study was performed among 60 respondents (20 respondents from each year) to check the reliability of the questionnaire. Conducted reliability analysis showed that Cronbach's alpha coefficient for second, third, and fourth-year questionnaire was 0.961, 0.958, and 0.887, respectively, indicating that the questionnaires were reliable. The SurveyMonkey Platform was utilised to create and collect responses. Links to the questionnaire was distributed among the students through WhatsApp application.

Statistical analysis

Data obtained from students' responses were analysed using the Statistical Package for Social Science (SPSS) version 26. For the actual study, collected data was summarised using frequency counts and percentages for ordinal categories. The Pearson Chi-square test was used to evaluate any significant difference between percentage of frequency responses for each question. The Mann-Whitney U test is used to compare differences between two independent groups. A p value <0.05 was considered as statistically significant.

Ethical clearance

This study was approved by UiTM Research Ethics Committee on 31st March 2021 with the reference number REC/03/2021 (UG/MR/228).

RESULT

Distribution of undergraduate pharmacy students in relation to gender and year of study

Overall, out of 526 B. Pharm students enrolled in the second to final year of study programme, a total of 302 (57.4%) students completed the survey. The third-year students make up the largest proportion (45.0%) of study participants. The majority of respondents were female (86.6%). Approximately one third (37.7%) of the respondents were with cumulative grade point average (CGPA) of 3.50 and above. The CGPA was significantly higher among females (3.39 ± 0.24 vs 3.31 ± 0.23 among males; P = 0.03).

Preferred methods of assessment for B.Pharm pharmacology course achievement in relation to study year

The majority of the second-year students that were involved in Peripheral Nervous System Pharmacology, do agree with the utilisation of all assessment types in this course which include MCQ test, PBL, written assignments consisting of short or long essay, and final assessment with 75.4%, 73.5%, 70.6%, and 68.6% responses, respectively.

For Respiratory & Renal System Pharmacology Course, PBL (73.6%) dominated the preference compared to MCQ (70%) or Final assessment (70%). However, the majority of students (62.8%) were disagreed with the use of CAL as assessment.

In general, the respondents were not averse to any of the assessment method utilised in Cardiovascular System Pharmacology course. These third-year student respondents indicated that the MCQ test (72.8%) was the most preferred assessments, followed by PBL (72.1%) at a close second in the rank, practical report (70.8%) and final assessment (65.7%).

The final-year student's preference of assessment method in Cancer Chemotherapeutics showed 86.1% of students agreed with the use of MCQ test, approximately 84% for both PBL and CBL, and least of all 62.5% for open book essay-based assessment.

Meanwhile, no significant correlation was found for the CGPA and preferred methods of assessment among students.

Perceptions of assessments

Table II shows the perceptions of second-year students towards the different assessments in Peripheral Nervous System Pharmacology. More than half of the respondents (75.5%) agreed that MCQ test provided them with feedback of their online pharmacology learning. Most respondents (88.7%) agreed that PBL helped them in enhancing critical and analytical thinking skills. More than three quarters of the respondents (86.7%) agreed

Table II: Second-year student's perceptions on method of assessment in Peripheral Nervous System Pharmacology (n=98)

Description	Likert scale score, N (%)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
MCQs Test					
i. Helped in understanding course material	0	2 (2.0%)	22 (22.5%)	60 (61.2%)	14 (14.3%)
ii. Strengthened my knowledge of course material	0	2 (2.0%)	27 (27.6%)	55 (56.1%)	14 (14.3%)
iii. Helped in enhancing critical and analytical thinking skill	0	4 (4.1%)	29 (29.6%)	54 (55.1%)	11 (11.2%)
iv. Helped in problem analysis	0	4 (4.1%)	29 (29.6%)	56 (57.1%)	9 (9.2%)
v. Provided feedback for my learning	0	2 (2.0%)	20 (20.4%)	60 (61.2%)	16 (16.4%)
PBL					
i. Helped in understanding course material	0	1 (1.1%)	12 (12.2%)	55 (56.1%)	30 (30.6%)
ii. Strengthened my knowledge of course material	0	3 (3.1%)	10 (10.2%)	50 (51.0%)	35 (35.7%)
iii. Helped in enhancing critical and analytical thinking skill	0	1 (1.1%)	10 (10.2%)	55 (56.1%)	32 (32.6%)
iv. Helped in problem analysis	0	0	12 (12.2%)	56 (57.2%)	30 (30.6%)
v. Provided feedback for my learning	0	1 (1.1%)	20 (20.4%)	55 (56.1%)	22 (22.5%)
Written Assignment					
i. Helped in understanding course material	0	0	13 (13.3%)	61 (62.2%)	24 (24.5%)
ii. Strengthened my knowledge of course material	1 (1.1%)	1 (1.1%)	17 (17.3%)	57 (58.1%)	22 (22.5%)
iii. Helped in enhancing critical and analytical thinking skill	0	0	16 (16.4%)	61 (62.2%)	21 (21.4%)
iv. Helped in problem analysis	0	0	14 (14.3%)	60 (61.2%)	24 (24.5%)
v. Provided feedback for my learning	1 (1.1%)	2 (2.0%)	20 (20.4%)	56 (57.2%)	19 (19.3%)
Final Assessment					
i. Helped in understanding course material	0	0	21 (21.5%)	57 (58.1%)	20 (20.4%)
ii. Strengthened my knowledge of course material	0	0	20 (20.4%)	55 (56.1%)	23 (23.5%)
iii. Helped in enhancing critical and analytical thinking skill	0	1 (1.1%)	17 (17.3%)	56 (57.2%)	24 (24.5%)
iv. Helped in problem analysis	0	2 (2.0%)	15 (15.3%)	60 (62.2%)	21 (21.4%)
v. Provided feedback for my learning	0	2 (2.0%)	19 (19.4%)	59 (60.2%)	18 (18.4%)

that written assignment benefited them in understanding course material delivered during class. Interestingly more than 80% of respondents agreed that the final assessment aided them problem analysis.

Perceptions of third-year students towards assessments utilised in Respiratory and Renal Systems Pharmacology and Cardiovascular Systems Pharmacology are presented in Table III and Table IV. In Respiratory and Renal Systems Pharmacology, majority of students 104 (76.5%) agreed that MCQ test strengthened their knowledge of course material. On top of that, there were 120 (88.2%) and 75 (55.1%) of third year students for both PBL and CAL, respectively, agreed that these two assessments helped them in problem analysis. Besides, most of the students 105 (77.2%) acknowledged that final assessment assisted them in improving critical and

Table III: Third-year student's perceptions on method of assessment in Respiratory and Renal Systems Pharmacology (n=136)

Description	Likert scale score, N (%)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
MCQs Test					
i. Helped in understanding course material	0	5 (3.7%)	35 (25.7%)	81 (59.6%)	15 (11.0%)
ii. Strengthened my knowledge of course material	0	6 (4.4%)	26 (19.1%)	91 (66.9%)	13 (9.6%)
iii. Helped in enhancing critical and analytical thinking skill	1 (0.7%)	11 (8.1%)	37 (27.2%)	77 (56.6%)	10 (7.4%)
iv. Helped in problem analysis	2 (1.5%)	6 (4.4%)	39 (28.7%)	80 (58.8%)	9 (6.6%)
v. Provided feedback for my learning	3 (2.2%)	14 (10.3%)	32 (23.5%)	77 (56.6%)	10 (7.4%)
PBL					
i. Helped in understanding course material	1 (0.7%)	2 (1.5%)	26 (19.1%)	89 (65.4%)	18 (13.3%)
ii. Strengthened my knowledge of course material	1 (0.7%)	5 (3.7%)	24 (17.6%)	87 (64.0%)	19 (14.0%)
iii. Helped in enhancing critical and analytical thinking skill	1 (0.7%)	3 (2.2%)	15 (11.0%)	93 (68.4%)	24 (17.7%)
iv. Helped in problem analysis	1 (0.7%)	1 (0.7%)	14 (10.4%)	97 (71.3%)	23 (16.9%)
v. Provided feedback for my learning	1 (0.7%)	4 (3.0%)	26 (19.1%)	87 (64.0%)	18 (13.2%)
CAL					
i. Helped in understanding course material	1 (0.7%)	21 (15.4%)	48 (35.3%)	59 (43.4%)	7 (5.2%)
ii. Strengthened my knowledge of course material	1 (0.7%)	19 (14.0%)	47 (34.6%)	60 (44.1%)	9 (6.6%)
iii. Helped in enhancing critical and analytical thinking skill	1 (0.7%)	18 (13.2%)	45 (33.1%)	62 (45.6%)	10 (7.4%)

CONTINUE

Table III: Third-year student's perceptions on method of assessment in Respiratory and Renal Systems Pharmacology (n=136) (CONT.)

Description	Likert scale score, N (%)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
iv. Helped in problem analysis	1 (0.7%)	17 (12.5%)	43 (31.6%)	63 (46.3%)	12 (8.8%)
v. Provided feedback for my learning	2 (1.5%)	19 (14.0%)	45 (33.1%)	61 (44.8%)	9 (6.6%)
Final Assessment					
i. Helped in understanding course material	1 (0.7%)	4 (2.9%)	31 (22.8%)	79 (58.1%)	21 (15.5%)
ii. Strengthened my knowledge of course material	0	5 (3.7%)	39 (28.7%)	68 (50.0%)	24 (17.6%)
i. Helped in enhancing critical and analytical thinking skill	0	6 (4.4%)	25 (18.4%)	82 (60.3%)	23 (16.9%)
iv. Helped in problem analysis	0	4 (2.9%)	32 (23.5%)	78 (57.4%)	22 (16.2%)
v. Provided feedback for my learning	0	6 (4.4%)	37 (27.2%)	74 (54.4%)	19 (14.0%)

Table IV: Third-year student's perceptions on method of assessment in Cardiovascular System Pharmacology (n=136)

Description	Likert scale score, N (%)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
MCQs Test					
i. Helped in understanding course material	0	4 (2.9%)	26 (19.1%)	94 (69.1%)	12 (8.9%)
ii. Strengthened my knowledge of course material	0	6 (4.4%)	33 (24.3%)	86 (63.2%)	11 (8.1%)
iii. Helped in enhancing critical and analytical thinking skill	0	10 (7.4%)	38 (27.9%)	81 (59.6%)	7 (5.1%)
iv. Helped in problem analysis	0	5 (3.7%)	39 (28.7%)	84 (61.8%)	8 (5.8%)
v. Provided feedback for my learning	1 (0.7%)	8 (5.8%)	36 (26.5%)	81 (59.6%)	10 (7.4%)
PBL					
i. Helped in understanding course material	0	2 (1.5%)	18 (13.2%)	105 (77.2%)	11 (8.1%)
ii. Strengthened my knowledge of course material	0	3 (2.2%)	21 (15.4%)	99 (72.8%)	13 (9.6%)
iii. Helped in enhancing critical and analytical thinking skill	0	1 (0.7%)	20 (14.7%)	101 (74.3%)	14 (10.3%)
iv. Helped in problem analysis	0	1 (0.7%)	20 (14.7%)	99 (72.8%)	16 (11.8%)
v. Provided feedback for my learning	0	9 (6.6%)	24 (17.7%)	94 (69.1%)	9 (6.6%)
Practical Report					
i. Helped in understanding course material	1 (0.7%)	9 (6.6%)	36 (26.5%)	81 (59.6%)	9 (6.6%)

CONTINUE

Table IV: Third-year student's perceptions on method of assessment in Cardiovascular System Pharmacology (n=136) (cont.)

Description	Likert scale score, N (%)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Practical Report					
ii. Strengthened my knowledge of course material	1 (0.7%)	9 (6.6%)	36 (26.5%)	81 (59.6%)	9 (6.6%)
iii. Helped in enhancing critical and analytical thinking skill	1 (0.7%)	8 (5.8%)	36 (26.5%)	82 (60.4%)	9 (6.6%)
iv. Helped in problem analysis	1 (0.7%)	7 (5.1%)	29 (21.4%)	89 (65.4%)	10 (7.4%)
v. Provided feedback for my learning	1 (0.7%)	12 (8.9%)	40 (29.4%)	77 (56.6%)	6 (4.4%)
Final Assessment					
i. Helped in understanding course material	0	4 (2.9%)	27 (19.9%)	93 (68.4%)	12 (8.9%)
ii. Strengthened my knowledge of course material	0	5 (3.7%)	32 (23.5%)	87 (63.9%)	12 (8.9%)
i. Helped in enhancing critical and analytical thinking skill	0	5 (3.7%)	25 (18.3%)	93 (68.4%)	13 (9.6%)
iv. Helped in problem analysis	0	5 (3.7%)	32 (23.5%)	90 (66.2%)	9 (6.6%)
v. Provided feedback for my learning	0	8 (5.8%)	40 (29.4%)	77 (56.6%)	11 (8.1%)

analytical thinking skill.

In Cardiovascular System Pharmacology, 106 (78.0%) and 116 (85.3%) of students agreed that both MCQ test and PBL, respectively, aided them in understanding of their course content conveyed during class. In addition, there were 115 (84.6%) responses for PBL and 99 (72.8%) responses for practical report, agreed that these assessments helped in problem analysis.

Current finding also showed majority of third-year students 106 (78.0%) agreed that the final assessment facilitated them in embellishing their critical and analytical thinking skill. In contrast, there was a small percentage of students (< 10%) disagreed that assessments assigned contributed to their knowledge and skills development.

Perceptions of final-year students on assessment method in Cancer Chemotherapeutics is shown in Table V. Most final year students, 58 (85.4%) agreed that MCQ test helped them to comprehend course material prepared in class besides equipped them feedback for learning. Other than that, 64 (94.1%) of students expressed that PBL also aided in comprehension of course material and in improvement of their analytical and critical thinking skill.

In the other hand, most students agreed that CBL

Table V: Final-year student's perceptions on method of assessment in Cancer Chemotherapeutics (n=68)

Description	Likert scale score, N (%)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
MCQs Test					
i. Helped in understanding course material	2 (2.9%)	2 (2.9%)	6 (8.8%)	44 (64.7%)	14 (20.7%)
ii. Strengthened my knowledge of course material	2 (2.9%)	1 (1.5%)	7 (10.3%)	48 (70.6%)	10 (14.7%)
iii. Helped in enhancing critical and analytical thinking skill	2 (2.8%)	4 (5.9%)	13 (19.1%)	39 (57.5%)	10 (14.7%)
iv. Helped in problem analysis	2 (2.8%)	6 (8.8%)	16 (23.6%)	36 (53.0%)	8 (11.8%)
v. Provided feedback for my learning	1 (1.5%)	2 (2.8%)	7 (10.3%)	41 (60.4%)	17 (25.0%)
PBL					
i. Helped in understanding course material	0	2 (2.8%)	2 (2.8%)	38 (52.9%)	26 (38.2%)
ii. Strengthened my knowledge of course material	0	2 (2.8%)	3 (4.4%)	32 (47.2%)	31 (45.6%)
iii. Helped in enhancing critical and analytical thinking skill	0	2 (2.8%)	2 (2.8%)	31 (45.6%)	33 (48.5%)
iv. Helped in problem analysis	0	2 (2.8%)	4 (5.9%)	30 (44.1%)	32 (47.2%)
v. Provided feedback for my learning	0	2 (2.8%)	8 (11.8%)	35 (51.5%)	23 (33.9%)
CBL					
i. Helped in understanding course material	0	2 (2.9%)	2 (2.9%)	39 (57.4%)	25 (36.8%)
ii. Strengthened my knowledge of course material	0	2 (2.9%)	2 (2.9%)	36 (52.9%)	28 (41.3%)
iii. Helped in enhancing critical and analytical thinking skill	0	2 (2.9%)	2 (2.9%)	34 (50.0%)	30 (44.2%)
iv. Helped in problem analysis	0	2 (2.9%)	1 (1.5%)	32 (47.1%)	33 (48.5%)
v. Provided feedback for my learning	0	2 (2.9%)	6 (8.8%)	37 (54.4%)	23 (33.9%)
Final Assessment					
i. Helped in understanding course material	1 (1.5%)	3 (4.4%)	16 (23.5%)	31 (45.6%)	17 (25.0%)
i. Strengthened my knowledge of course material	1 (1.5%)	2 (2.9%)	14 (20.6%)	33 (48.5%)	18 (26.5%)
iii. Helped in enhancing critical and analytical thinking skill	1 (1.5%)	2 (2.9%)	16 (23.5%)	32 (47.1%)	17 (25.0%)
iv. Helped in problem analysis	1 (1.5%)	3 (4.4%)	16 (23.5%)	31 (45.6%)	17 (25.0%)
v. Provided feedback for my learning	1 (1.5%)	2 (2.9%)	14 (20.6%)	32 (47.1%)	19 (27.9%)

contributed in providing students feedback for learning as it received 60 (88.3%) responses. In addition, 51 (75.0%) of final year students approved that final assessment did strengthen their knowledge of course material delivered during learning. There were small proportion of students around 4.4% to 11.6%, disagreed that MCQ and final test contributed to knowledge and skills development.

Table VI shows responses on how B. Pharm students viewed the assessments in general. 270 (89.4%) students marked that assessment quantifies their knowledge and/or competence level, while 278 (92.1%) and 268 (88.7%) students agreed that assessment enables them to identify and address gaps in learning, respectively.

Table VI: Student's reflection on how method of assessment is perceived

Statements	Yes, N (%)			No, N (%)		
	2nd year	**3rd year**	**4th year**	**2nd year**	**3rd year**	**4th year**
Assessment quantifies my level of knowledge and/or competence	94 (95.9%)	121 (89.0%)	55 (80.9%)	4 (4.1%)	15 (11.0%)	13 (19.1%)
	Total: 270 (89.4%)			Total: 32 (10.6%)		
Assessment helps me identify current gaps in learning	92 (93.9%)	124 (91.2%)	62 (91.2%)	6 (6.1%)	12 (8.8%)	6 (8.8%)
	Total: 278 (92.1%)			Total: 24 (7.9%)		
Assessment enables me to address gaps in learning	89 (90.8%)	117 (86.0%)	62 (91.2%)	9 (9.2%)	19 (14.0%)	6 (8.8%)
	Total: 268 (88.7%)			Total: 34 (11.3%)		

DISCUSSION

In light of recent shift to online learning, investigation into students' preferences of assessment methods, as well as their perceptions, are vital for understanding the factors that influence the learning process and its outcomes. Previous studies have demonstrated that disparities in student learning and preferences contribute to disparities in performance (8,11,12). Furthermore, it has been asserted that students' preferences for instruction and evaluation reflect their perception of the learning environment, their learning idea, and approaches to learning, all of which will likely influence their accomplishment (9,13). The effectiveness of learning is determined by the degree to which the instructional and assessment processes are in sync. If the method of instruction and assessment are not in sync, the quality of learning will suffer (14).

Pharmacy education is assessment-driven. Assessment influences curriculum and, more crucially, stimulates student learning, in addition to making judgments about

a candidate's competency or performance (15). Thus, it is valuable to consider assessment preference among students, their perception of experienced assessments as well as how they perceived assessment as a whole. In this present study, MCQ test, written assignment, and final examination are considered as traditional assessment.

In a brief, traditional assessment refers to standardized testing that employs questions with a limited number of answer options. It includes multiple-choice, true or false and short answer responses (16). Meanwhile, PBL, CAL, CBL, and practical report are categorized in alternative assessment. Alternative assessment is a more practical and experimental approach of evaluation which requires students to participate in variety of tasks that need them to use their analytical, reasoning and logical thinking skill.

Irrespective of years of study, students seem to agree with almost all types of assessment method assigned in respective courses taken namely MCQs test, PBL and final assessment. Other assessments such as written assessments, practical report, and CBL also received positive responses indicating their agreement with the assessments conducted. Above all preferences in assessments conducted, current study disclosed that MCQs test was the most preferred types of assessment in pharmacology online learning among most of B. Pharm students as this is not an unfamiliar method of assessment for them. Besides that, the used of interactive platform to conduct MCQs test (e.g Kahoot, Quizizz) is also the contributing factor of the increment of the preferences among the students.

In a study by Atabay et al. (17), students prefer MCQs because they are easier to prepare for and take, and they provide more points. However, MCQs is usually used effectively for testing items that demand low cognitive effort, for instance, recalling previously memorized knowledge (18). This is supported by other previous study which underpinned that MCQs test is perceived as only suitable in measuring lower order cognitive processes, such as those involved in factual knowledge development (15).

Sambell et al. (19) claimed that traditional assessment is seen to be ineffective as a measure because it looked to measure only memory, or in the case of essay-writing assignments, the ability to assemble a list of facts and details. Van de Watering et al. (20) in their study, stated that students preferred written test, including take-home exams and papers as they are permitted to use various supporting materials such as books and notes, as well as papers or projects.

Similarly, preference for assessment formats with the use of supporting material has been shown in previous studies in which student preferred easy-to take, limited time consuming as well as stress and anxiety reducing assessment formats (20,21). Time constraints are seen to be stressful at which can cause agitation hence increase pressure on students to complete tasks given. Assessment formats which reduce stress is believed to be able to increase the probability of success (21).

During this pandemic, the role of information technology is significant due to closure of educational institutions (22). Nowadays, with all speedy development of technologies, students could even look for the supporting materials on any online websites when they have no physical books or notes, especially in the sudden adaptation towards online learning due to Covid-19. This to some extent proves preference of written assignment among second-year students during their previous ODL session.

On the other side, alternative assessment was thought to be more equitable than traditional assessment because it appeared to examine skills, competences and quality in the learning process and its outcome among students. In contrast to traditional exams, which rely on recollection of in-class information, alternative assessment methods place a greater emphasis on higher order thinking skills (23). Thus, it allowed students to demonstrate the breadth of their learning and to communicate more clearly and exactly what they had acquired during the learning programme (19).

In this current study, PBL was the most favourable assessment particularly in Respiratory and Renal Systems Pharmacology among third-year students as in their perception, PBL helped in enhancing critical and analytical thinking and problem analysis skill. PBL was conducted thru Padlet and Google Meet application where the students can synchronously discuss the problem among each other and at the same time sharing their finding information thru Padlet where they can go back and read again.

A study by Zhou et al. (24) demonstrated basic progress in PBL teaching method whereby it requires students to lay out problem in the given case study, search information, group discussion, summary, and effectiveness evaluation. In this previous published study, pharmacy students were more enthusiastic about PBL than traditional assessment. Previous finding also stated that PBL technique outperformed traditional teaching techniques in terms of increasing students' learning interest, independent analysis skills, scope of knowledge, self-study, team collaboration, and oral expression (24). Practically, CBL that is implemented in Cancer Chemotherapeutics course of third-year students in this recent study, has same basic concept as PBL.

Conversely, CAL assessment was not a preferred method of assessment in the third-year students of Respiratory and Renal Systems Pharmacology. It received highest

negative responses over other methods of assessment assigned. Laboratory-based practical has long been an integral component in pharmacology education. It demonstrates students of drug effects on tissues or on whole animal (25). Increasing ethical concerns with the use of animals for undergraduate training and development of information technology is the contributing factor of replacing laboratory based practical session to CAL today (26)

Previous study by Sharma et al. (27) has shown that CAL, an alternative assessment, is an effective technique of practical in pharmacology since the experiments provided in CAL are easier to remember. CAL is also welcomed as a deviation from traditional animal laboratory experiments and is proposed to be undertaken as an adjunct to practical classes. Furthermore, current computers with multimedia and presentational capabilities can give an interactive and individualised learning experience, encouraging active and self-directed learning (28). This can be put another way that CAL facilitates students to learn at their own pace to actually study the responses to a particular drug which is advantageous for slow learner (29).

Despite its advantages, CAL has several drawbacks. Because the intended experiment is set at a fixed dose, students usually are unable to observe the biological reaction at each desired dose. Moreover, students tend to lose their skill and expertise on practical knowledge in conducting the experiments especially during the Covid-19 pandemic, whereby they have not physically conducted practical classes for a quite long time. Eventually, it is easily often forgotten compared to traditional animal experiments (26,30). Hence, having CAL during online learning was quite complicated, thus resulting in it being the least preferred assessment method compared to others. Another reason on the lower preference of CAL is probably student not familiar with such a concept in context of assessment (31).

Various type of assessments can influence perception of assessment among students. According to previous studies, student's perceptions of assessment can be classified based on their experiences receiving various forms of assessment during teaching and learning activities. There are six categories of student assessment perceptions with particular indications, including perceptions of the requirement to reproduce knowledge, rehearsing, accountability, enhancing learning, problem solving, and critical judgement. (32,33). In this present study, five indicators were used in determining to what extent has assessments experienced contribute to student's knowledge and skill development. Indicators include understanding towards course material, knowledge strength across course material delivered, critical and analytical thinking skill, problem analysis, as well as evaluation feedback in online pharmacology learning.

Following student's responses on perception on assessment experienced, majority of students highly agreed that MCQ test did help them in understanding course content delivered throughout learning, strengthened their knowledge, and provided them learning feedback. Assessment with MCQs format is used to evaluate student's capacity in remembering exact data or fact, interpreting data or analysing proposed material (34). Understanding of learning material to some extent depends on the ability and capacity to remember facts or information learned. Students most likely can understand more as their factual memorizing increases. Once understanding in content delivered increased, it strengthened knowledge as well as memory. Thus, it allowed students to carefully analyse problem proposed in assessment conducted and provided them feedback based on how much they have learnt.

On the other hand, current finding revealed that PBL and other alternative assessments such as CBL, CAL and practical report in student's perspective across different pharmacology course, showed that most of alternative assessments played a great part in helping them to understand more of course material, enhanced analytical and critical thinking skills, as well as assisted them in analysing problem. PBL environment in higher education is meant to guide students to become experts in a subject of study, capable of recognizing a discipline's problem and analysing and suggesting solution. PBL primarily affects student's focus on the application of knowledge.

PBL is described as a teaching method involving effort to understand or resolve a problem. The problem is encountered first in the learning process. Then, it serves as a focal point or stimulus for the application of problem-solving or reasoning abilities, as well as the search for knowledge needed to comprehend the mechanism generating the problem and how it can be solved (35). In PBL, students are usually assigned to groups of 15 and each group is facilitated with a lecturer. This model is very student-centred. Instead of lecturer acts as direct source of information, lecturer only serves as facilitator of information (36). Moreover, with active participation and discussion between group members, PBL actually encourages students in understanding topic in different and better way (36,37).

Meanwhile, CBL is an assessment method where a whole case is given to the student for study prior to or during class discussion, which is also facilitated by a tutor. This method incorporates both student- and teacher-directed learning (38). Current study showed that CBL which was conducted in final year pharmacology course, highly contributed in students understanding and reinforcing of in-class learning material, besides helped them in heightening thinking skills and problem analysis. The result of this present finding seems to concur with previous published research which stated that case-

based teaching and learning did pose challenging case study and questions. This somehow helps students to develop analytical and critical thinking skills which will be kind of guidance for them in future (37).

As mentioned before, practical report is also one of the alternative assessments. Practical activity is an engaging way of teaching that is vital for ensuring that students not only hear, but also grasp the concepts, and can associate theory and application (39). Particularly, practical activity which was performed among third year students in Cardiovascular System Pharmacology disclosed that it benefited students the most in problem analysis. The practical usually is physically conducted, but due to pandemic constraint, lecturers in charge performed the designed experiment in real-time, recorded the video of experiment and blasted it to students. So, based on the prepared experimental video, students were required to use their knowledge to relate and apply the concept learned. Students then analysed problem proposed in order to provide information for report writing. Not only it helps in problem analysis, it also actually measures students understanding level in topic discussed during practical class (40).

Apart from that, alternative assessment is used in evaluation to collect data regarding student's performance and progress from different sources to achieve the objectives. In support, alternative assessments provide means of assessing valued skills that cannot be directly assessed with traditional test. They facilitate a more realistic setting for student's performance rather than traditional test. Student's perception on alternative assessment is important as it affects their learning approach, and in turn, affects the extent to which learning is successful in classroom. Besides, it will also assist teachers in finding correct assessment to be applied in classroom (41).

Concerning on final assessment during ODL, it is an online open-book examination conducted to evaluate B. Pharm student's learning outcomes. Based on the result of current study, majority of students agreed that final examination strengthened their knowledge, built up and boosted their critical and analytical thinking skill, and helped in problem analysis. This can be further explained at which essay questions developed in final assessment mostly require high order thinking skill, great and strong knowledge in answering the proposed material. Critical questions generated in open book examination also lead them to develop deep understanding of course material which concurs with result of other study (42).

Critical thinking is a way of thinking about any problem or subject in which students can increase the quality of their thinking by masterfully controlling the structures of thought and enforcing intellectual standards on them (43). These intellectual standards include relevance, significance, accuracy, clarity, precision, breadth, depth, logic, and fairness (44). The most desirable qualities for a pharmacy graduate are analytical and critical thinking, as pharmacists must think for themselves, question claims, apply excellent judgement, and make decisions (45,46). It is necessary facet in pharmacy practice in order to properly manage, resolve medication problems and assess treatment outcomes for patient safety and well-being (47,48).

With regards to questionnaire on how students perceived method of assessment, study found that almost all students in their second-, third-, and final-year expressed that assessment given based on the respective pharmacology course appraises their knowledge and competence besides helps them to identify and address gaps in learning. Education system utilises assessment to gauge student's academic strength and weakness. They rely on assessment to measure the quality of learning outcomes (49). In support, it assesses student learning and identifies specific misunderstandings so that students can learn more successfully. It affects both the quality of teaching and the quality of learning (50). Besides, learning gap is about the discrepancy between what students should have learned by a specific level and what they have actually learned up until that point. If the gaps are not carefully addressed, students will likely fall further behind as a result of the skills and information they lack.

CONCLUSION

In short, this study concludes that MCQ test is the most preferred type of assessment among pharmacy students irrespective of years of study during online pharmacology learning compared to other assessments conducted. PBL is also another favoured assessment. Assessments conducted in respective pharmacology course benefited students in understanding and strengthening their knowledge in course content conveyed during class. Apart from that, assessments also assisted students to reinforce their critical and analytical thinking skills as well as to analyse, solve the problem and provide learning feedback. All in all, exploring students' preference and perceptions of the assessment performed can help the institution to improve quality of assessment for students especially in online pharmacology education.

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