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Online Assessment using Secured Open Source Platform in a Malaysian Public University Medical School: Perceived Usefulness, Perceived Ease of Use and Acceptance

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ABSTRACT

Online teaching, learning, and assessment have become the new norms in higher education institutions, including medical schools. With the emergence of the Covid-19 pandemic medical schools worldwide have been compelled to adopt the online mode of curriculum delivery for their students. This research aims to explore the perceptions of medical students in terms of perceived usefulness, perceived ease of use, and acceptance of online assessments using a secured open-source Moodle platform at the USM School of Medical Sciences. The mixed-method design was used in this study. Furthermore, data were collected from medical students across year 1, year 2 and year 4. We utilized Google Form to collect the data. Demographic and quantitative data were analyzed using SPSS version 27, whereas qualitative data were analyzed using ATLAS.ti version 9. Our study has found that the items for perceived usefulness, perceive ease of use and acceptance have a mean score of more than 4.00 (positive areas) except for one item which is "I prefer online assessment compared to paper-based assessment" with a mean score of 3.78. No item had a mean score below 3.00 (areas of concern). For the qualitative data, the total number of codes generated was 336. Eight subthemes emerged from the advantages theme, 11 from the disadvantages theme, and 11 from the suggestions theme. In conclusion, online assessment using Moodle is perceived as a feasible and acceptable replacement for traditional face-to-face assessments, especially for theory assessment. However, a few disadvantages may compromise the validity and reliability of the assessment. Thus, medical schools must try their best to address these issues to minimize the negative aspects of online assessment.

***Keywords**:* Covid-19, online assessment, Moodle, learning management system, pandemic.

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INTRODUCTION

Some medical educators were hesitant to abandon their conventional methods of teaching and learning online prior to the global epidemic. The creation and execution of online learning activities appeared to face numerous obstacles (1). However, in response to the COVID-19 epidemic, this method has become the new standard in medical curriculum. It forced medical schools to switch from traditional in-person, face-to-face settings to online settings (2).To curb the spread of the virus, most medical schools across the globe have limited curriculum activities that require face-to-face interactions. To ensure that the effectiveness of teaching and learning is maintained, higher education providers must find the best approach to deliver course content, engage learners, and conduct online assessments (3).

Despite encountering numerous challenges, the pandemic undeniably brought about some positive changes for medical schools worldwide. Limited physical presence has nurtured an online learning environment comprising both asynchronous and synchronous distance education. Additionally, this encourages the creation of novel student assessment techniques (4). However, there are issues with effectiveness, security, and efficiency when evaluating students online, especially when it comes to high-stakes exams. Therefore, medical schools need to ensure that online assessment is at least at par with, if not better than, traditional assessments.

In Malaysia, all public universities have established their own e-learning portals to facilitate online learning and assessment. These portals serve as centralized platforms where students and educators can access course materials, submit assignments, participate in discussions, and conduct assessments. The majority of these portals are built on the Moodle (https://moodle.org/) Learning Management System (LMS) (Table 1), an open-source platform widely recognized for its flexibility, scalability, and cost-effectiveness (6)

Moodle's user-friendly interface and customizable features make it a preferred choice for universities, allowing them to tailor the system to meet specific institutional requirements. Through Moodle, universities can integrate various tools and plugins, such as proctoring systems, discussion forums, and interactive quizzes, to enhance the learning experience.

Table 1: LMS of the public universities in Malaysia

University	LMS	Name
Universiti of Malaya	Moodle	SPeCTRUM
Universiti Sains Malaysia	Moodle	eLearn@USM
Universiti Kebangsaan Malaysia	Moodle	UKMFolio
International Islamic University Malaysia	Moodle	iTa'LeEM
Universiti Putra Malaysia Moodle	PutraBLAST	PutraMOOC
Universiti Malaysia Sarawak	Moodle	UNIMAS eLeap
Universiti Malaysia Sabah	Moodle	smart3V
Universiti Teknologi MARA	Home-grown	i-Learn
Universiti Sains Islam Malaysia	Moodle	GOALS
Universiti Sultan Zainal Abidin	Moodle	e-KeLIP
Universiti Pertahanan Nasional Malaysia	Moodle	eLearningv2 UPNM

Apart from teaching and learning, the USM School of Medical Sciences utilizes the Moodle platform (https://examonline.usm.my/) for online assessments. The assessment formats include Multiple True/False, Single Best Answer, Scenario-Based Questions, and Short Essay Questions. Some clinical examinations, such as the Objective Structured Clinical Examination (OSCE), are also conducted using this platform, especially during the pandemic. However, in order to guarantee the assessment's validity and reliability, both short and long case exams were administered in person.

In terms of examination process, it begins with preparation steps where faculty members construct the questions which is then followed by a vetting process. After that, the vetted questions will be uploaded by the course coordinator to the Moodle's built-in question bank. The course coordinator will then set the examination settings including date, the duration, time window for access, grading criteria, and instructions for students. Additional security settings, such as randomization of questions and answers or time limits per question are applied to reduce cheating.

To make sure it can manage the anticipated volume of concurrent users, the platform is tested. To help them become acquainted with the system and handle any possible technological difficulties, students are given a practice exam. At the scheduled time, the exam becomes available to students. To monitor students' activities and ensure academic integrity, proctoring tools incorporated (e.g., webcam and LockDown Browser) and integrated with Moodle.

Moodle comes with many advantages for teaching, learning, and assessment. The platform is open-source software souce(7) (8) which can be used for free. However, to enhance its security related to online assessment, the university has integrated the platform with a secured proctoring system called Respondus LockDown Browser. This prevents examinees from printing, copying, browsing other websites, or accessing other applications during the assessment (9). Experts have described the Moodle platform as being extremely user-friendly (10). Furthermore, Moodle boasts numerous advantages compared to other platforms, having been extensively employed in teaching and learning activities for several years. Nevertheless, there is a paucity of studies evaluating its usability for student assessment.

This study aimed to investigate the perception of examinees in terms of perceived usefulness, perceived ease of use, and acceptance of the online assessment at the USM School of Medical Sciences. It also explores its advantages and disadvantages, and provides suggestions to improve the assessment practice. We hope that this article will contribute to the literature and provide guidance to other medical schools to improve their practice of online student assessment.

Methodology

Setting and population

This study was conducted at the USM School of Medical Sciences. The school uses the Moodle platform for online teaching and learning activities. Previously, we used a physical face-to-face approach for student assessment. However, during the pandemic, the school changed most of the assessments to online platforms using Moodle, open-source LMS. The process of changing from face-to-face online teaching and learning was not too difficult, since we had been using the platform for many years. However, in terms of assessment, this was not the case, especially for clinical assessments, which require examinees to interact with real patients.

Research Design

This study utilized cross-sectional design. The population is undergraduate medical students from Universiti Sains Malaysia (USM) School of Medical Sciences. An online survey was distributed using

Google Forms. The participants were year 1–2 and year 4 students, representing the non-clinical and clinical phases, respectively. Year 3 and final year students were excluded because they were undergoing semester examination during data collection. The survey form comprised three sections: demographic data, quantitative data, and qualitative data. The online survey was distributed via WhatsApp a few days after the semester's examinations, with participants requested to provide their feedback within one week.

Sampling Method

Convenience sampling was utilized. Participants were selected based on their availability, accessibility, and willingness to participate. The researchers distributed the survey through WhatsApp. The researchers asked student representative to send the information to their batchmates ensuring it reached all target participants.

Quantitative

For the quantitative sections, we designed a questionnaire to evaluate the perceived usefulness, perceived ease of use, and user acceptance. These items were adapted from technology-enhanced model (TAM) developed by Davis(11). The questionnaire was self-administered, requiring participants to respond using their personal devices. TAM evaluates three critical constructs: perceived usefulness, which refer to the extent to which users believe a technology will enhance their performance; perceived ease of use, which reflects how straightforward and user-friendly the technology is; and user acceptance, defined as the willingness to adopt the technology based on its perceived benefits and ease of use. These constructs align seamlessly with the study's objective of assessing the usability and acceptance of online assessments conducted via Moodle. The TAM framework has been extensively validated across various contexts, including educational technology, making it a robust and reliable choice for this research.

A pilot study was not conducted for this research because of several reasons. Conducting a pilot study could have delayed the primary data collection, which was time-sensitive, as feedback needed to be gathered shortly after semester assessments and before the break. Additionally, the questionnaire is a standardized tool with a well-established record of reliability and validity, as its core items have been extensively tested in prior studies By utilizing a validated framework and prioritizing timely data collection, the study maintained both efficiency and relevance.

For items related to perceived usefulness, perceived ease of use, and acceptance of the online assessment in School of Medical Sciences, each item was rated on a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The mean scores were categorized into positive areas (any scores equal to or more than 4.00), areas for improvement (any scores between 3.00 and 3.99), and areas of concern (any scores less than 3.00). Apart from the items, we also asked specific questions including the type of Internet connection used, technical issues, and their experience while going through the online assessment.

Qualitative

Data collection and analysis

For qualitative sections, three semi-structured questions were asked: 1) describe the advantages of the online assessment, 2) describe the disadvantages of the online assessment, and 3) provide feedback related to the online assessment. The responses from the participants in the Google Form were then transferred into three separate Microsoft Words: advantages, disadvantages, and suggestions. The document was then analyzed using ATLAS.ti 9 software(12). The three steps in the procedure were: (i) managing the data, (ii) understanding the data, and (iii) interpreting the data.

Managing the data

Each quotation was labelled with a specific code, e.g. D1-P1021. “D1” indicates document 1. “P1021” indicates a participant’s code number. Each respondent was anonymously coded.

Understanding the data

Each statement was carefully read to discern the concepts, ideas, and terminology related to the research objectives. Relevant information was selected based on the research objective. This step was performed by the MAAI and reviewed by all other authors.

Interpretation of the data

Each quotation was coded using a thematic analysis (13) software. The codes were then categorized and subthemes emerged. Thematic maps generated by the software were reviewed to discern the relationships among the themes. Several measures were taken to enhance the validity of the findings and ensure the credibility, transferability, confirmability, and dependability of the data. Trustworthiness criteria were applied to ensure the rigor of the qualitative research findings (14).

Triangulation process

To ensure the validity and reliability of qualitative findings in the study, a triangulation process has been implemented. Data triangulation involves gathering feedback from diverse participant groups, such as students from different academic years (Year 1, 2 and 4), academic phases (non-clinical and clinical), and demographics (in-campus vs. out campus). This approach ensures a balanced representation and captures varied perspectives on online assessments. Additionally, comparing responses across these groups helps identify unique experiences based on situational or demographic factors.

Methodological triangulation leverages the study's mixed-method design by cross-validating quantitative and qualitative findings. Quantitative data, such as mean scores for perceived usefulness, ease of use, and acceptance, can support or contrast themes derived from qualitative analysis. For instance, high ease-of-use scores from quantitative responses can be explained through qualitative insights highlighting specific platform features like flexibility and user-friendliness. This integration ensures a comprehensive understanding of the findings.

Investigator triangulation involves multiple researchers participating in data analysis. Independent coding of qualitative responses followed by thematic discussions ensures consistency and reduces bias in interpreting themes. Tools like ATLAS.ti can facilitate the generation of thematic maps, which multiple analysts can review and refine collaboratively. Regular team discussions were also carried out. This may help resolve discrepancies and ensure robust findings.

Ethical Considerations

This study was exempted from ethical review by The Human Research Ethics Committee of USM (JEPeM Code : USM/JEPeM/KK/23030255). It was initially conducted by the Department of Medical Education for curriculum monitoring purposes. The findings were presented to the academic school committee. A key ethical consideration was to ensure that the participants felt free to share their honest feedback without any fear of repercussions, because the survey was entirely anonymous. The researcher had no opportunity to identify who had responded or completed the survey and who had not. Participants were also aware that there was no possibility of linking their responses to their identities.

RESULTS

The Quantitative

Participants' profiles

A total of 332 students participated in the study. The complete demographic profiles of the participants are presented in Table1 below.

Table 1: Demographic profile

Variable		Frequency (n)	Percent (%)
Campus	PPSP	300	90.4
	USM-KLE	32	9.6.
Year of study	Year 1	126	38.0
	Year 2	106	31.9
	Year 4	100	30.1
Nationality	Local students	418	97.4
	International students	11	2.6.

Gender	Male	104	31.3
	Female	228	68.7
Location during exam	In campus	166	50.0
	Out campus	166	50.0

Table 2 shows the participants' perceptions of technical issues related to online assessment.

Table 2: Technicalities in online assessment

	Items		**Frequency, n**	**Percent (%)**
1	Internet Source	Broadband	15	3.5
		WIFI	348	81.1
		LAN Cable	66	15.4
2	I have experienced no technical issues during the online assessment	Yes	209	48.7
		No	189	44.1
		Not sure	31	7.2
3	I have experienced no difficulty in navigating questions in the portal	Yes	321	74.8
		No	88	20.5
		Not sure	20	4.7
4	I have experienced no difficulty related to lockdown browser	Yes	255	59.4
		No	142	33.1
		Not sure	32	7.5
5	I have experienced no difficulty related to proctoring/Webex webcam monitoring	Yes	303	70.6
		No	96	22.4
		Not sure	30	7.0
6	The answering time given to me during online assessment is	Appropriate	372	86.7
		Too short	44	10.3
		Too long	13	3.0

Perceive usefulness, perceive ease of use and acceptance of online assessment

Table 3: Perceive usefulness, perceive ease of use and acceptance of online assessment.

Domain	*Items*	*Mean*(n= 429)*	*Std. Dev.*
Perceive usefulness	The platform makes assessment activity run smoothly	4.18	0.960
	The platform used makes assessment feasible (during pandemic)	4.44	0.773
	The platform is effective	4.34	0.857
Perceive ease of use	The platform is easy to use	4.42	0.807
	The platform used is user friendly	4.30	0.938
	The instruction for the assessment was clear and understandable	4.59	0.649
	The platform is flexible (example: can use any device, ect)	4.14	1.032
Acceptance	I prefer online assessment compared to paper-based assessment	3.78	1.231
	Generally, the online assessment is acceptable to replace paper-based assessment	4.08	1.095

**The mean scores ≥ 4.00 = Positive areas; 3.00 to 3.99 = Areas for improvement: and ≤ 3.00 = Areas of concern*

All the items for perceive usefulness, perceive ease of use and acceptance have a mean score of more than 4.00 (positive areas) except for items "I prefer online assessment compared to paper-based assessment" which has a mean score of 3.78 (areas for improvement). No item with a mean score below 3.00 (areas of concern)

The Qualitative

A total of 336 codes were generated. These were then grouped into three themes: advantages, disadvantages, and suggestions. Eight sub-themes emerged for advantages, 11 for disadvantages, and 11 for suggestions.

Theme 1: Advantages of online assessment

Eight subthemes emerged under the theme of advantage (Table 4). Participants perceived the online exam to be better than the traditional one. Generally, it is acceptable to replace traditional face-to-face assessments, particularly during pandemics. The absence of physical presence is one of the major advantages of online assessments. This can reduce physical contact.

The participants also perceived that the online assessment makes them less stressed, especially from assessment-related stressors, and that it is more flexible and comfortable. It was also better in terms of saving time and reducing costs and energy. In addition, the online assessment has the advantage of preserving mother nature.

Table 4: List of subthemes and examples of quotations for theme 1.

Subthemes		Num. of codes	Num. of quotations	Sample of quotations
1	Better than traditional assessment	45	88	*"I like the most the fact that I can type rather than writing. Not tiring plus I can easily edit my answers without the need of crossing out (if written). My answers submitted too will be neat. Typing saves time and its handy because it helps me to be able to answer all questions."* D1-P1129 *"I'm able to correct the answer without produce a mess since we can delete easily.. And we also can add on the point in the middle of essay. And im not worried with my handwritting anymore."* D1-P1359
2	Acceptable	9	11	*"Suitable for situation we are in currently- pandemic."* S1-P1341
3	Physical distancing	11	31	*"Feasible, easily accessible, no travelling required, safe from covid19 as no physical contact with other humans"*. D1-P1342
4	Less exam related stress	20	38	*"I can just focus on myself without any interruption from the surrounding. For example, students who finish and leave thr exam hall might provide additional pressure to me during assessment."* D1_P1200 *"Could say sort of nervous-free , no f2f OSCE etc, so our brain can focus on answering the questions without interference of irregular heartbeat, mood imbalance, the waiting moment of 8-minute bell ringing"*. D1-P1052
5	More flexible	12	44	*"I am more comfortable answering question anywhere I want."* D1-P1070 *"In terms of formal attire, online assessment is much more flexible."* D1-P1040 *"At home and at one place (no moving around) so it is easier. Don't feel as anxious and nerve wrecking sitting in exam room and it is good."* D1-P1170
6	More comfortable	18	58	*"Comfortable since I can sit any position I want and because I can put pillow behind me since I always have back pain."* D1-P1045 *"Can do assessment at your own place peacefully without disturbance."* D1-P1334

7	Save time, cost, and energy	15	30	*"Reduce covid transmission, reduce cost and time for transport, reduce waste of paper."* D1-P1063 *"Save lots of time and energy before arrival at exam hall."* D1-P1052
8	Environmental friendly	5	22	*"Can save our mother nature from using tree."* D1-P1246 *"Online assessment is a very good way to make our journey towards paperless solutions for the better of the environment."* D1-1012

Theme 2: Disadvantages of online assessment

Eleven subthemes emerged under the disadvantaged category (Table 5). Even though some students perceived online assessment as better than the traditional assessment, some perceived it differently. However, online assessments are not as effective as traditional assessments. It has limitations, especially in assessing psychomotor skills.

Some of the participants mentioned that the online assessment does not have *"... assessment pressure and no assessment feeling."* (D2-P1213). In addition, some participants described that the online assessment induced more stress, and they felt more anxious. In addition to these psychological aspects, other disadvantages of online assessments include technical, internet connection, and server issues. Some of these issues are interrelated. For example, the internet connection issues leads to stress as mentioned by one of the participant, *"I feel very nervous and scared if there is a connection problem."* D2-P1247.

In addition, the hardware required for online assessment, the limitations of the Moodle platform, lockdown browser issues, and risks of cheating make participants feel that the online assessment has its own limitations.

Table 5: List of subthemes and examples of quotations for theme 2.

Subthemes		Num. of codes	Num. of quotations	Sample of quotations
1	Acceptability issues	*36*	*43*	*"Got lots of technical problem, disturbance from family especially little sister, cannot too focus during assessment."* D2-P1295 *"Sometimes my family members talk very loud and I can hear them while taking the exam. Also, exam online does not give me much motivation as it feels like I am going through all of this alone."* D2-P1174

				"Not effective as real exam." D2-P1178
2	Difficult to assess psychomotor	*8*	*11*	*"for OSCE certain questions are quite hard to answer by writing so its better by interactive session."* D2-P1121 *"Student become incompetent especially for osce questions because when online, the questions is direct compared to face to face osce, the examiner (interactive station) will ask much questions and sometimes they just ask basic knowledges to test us but maybe some of us unable to answer it because of less exposure to the interactive station."* D2-P1056
3	Lack of assessment vibe	*7*	*12*	*"...Exam online does not give me much motivation as it feels like I am going through all of this alone."* D2-P1174 *"Did not feel assessment pressure and no exam feeling."* D2-P1213
4	More anxious and stressful	*9*	*13*	*"When there is blackout and when Internet connection is not stable, then it can cause a huge distress to me as I won't be able to complete the paper."* D2-P1200 *"I feel very nervous and scared if the connection problem."* D2-P1247
5	Technical issues	*28*	*61*	*"Expose to unnecessary technical issue that affect the performance during assessment."* D2-P1356 *"If there's any problem occur it will be hard to reach out someone for help*." D2-P1260
6	Internet connection issues	*16*	*61*	*"There may be some internet speed problem occur unexpectedly, or any technical issue that could disturb our answering process."* D2-P1005 *"Undeniably, internet connection speed and technical issues (laptop, lockdown browser) are the main concerns here than need to tackled and improved."* D2-P1305
7	Server issues	*6*	*11*	*"I had to log in multiple times and go through same process over and over because the system said "session expired". It was so trouble and fear-inducing."* D2-P1266 *"Make sure the system don't have any problems before student assess it to answer the exam questions. Because, during exam GMT109 Genitourinary system. All my batchmates and i encounter problem where the system is down and we need to wait for repair before continue answering again."* D2-P1173
8	Hardware issues	*6*	*8*	*"Need to setup laptop make the preparation a little harder."* D2-P1320 *"Requires a lot of devices and facilities by students on their own. Not all students are privileged to have all the devices*

				up to date as the system requires devices that are up to date. Internet connection, even in the campus, is not optimum and sometimes unstable (in USM-KLE) ". D2-P1234
9	Limitation of Moodle platform	*7*	*12*	*"the urge to jot down notes at the question paper, to highlight important points, to exclude certain points can't be done via online paper."* D2-P1052 *"Difficulty to draw certain some conceptual framework to explain our answer."* D2-P1368
10	Lockdown browser issues	*14*	*20*	*"Technical issue with lockdown browser, sometimes unstable internet connection."* D2-P1265 *"The online assessment sometimes crash when we are answering. Thus we need to relog and exit the lockdown browser and it surely costs our precious time during assessment and raise anxiety among the students. Of course the situation will be stressful and concentration is hampered."* D2-P1305
11	Risks of cheating	*2*	*4*	*"So many people being dishonest, some of us work hard for what we get, some just...copy."* D2-P1006

Theme 3: Suggestions for improvement

Eleven subthemes emerged under the suggested theme (Table 5). Participants suggested that school revert from the online assessment to a traditional face-to-face assessment. However, some participants suggested continuing the online assessment especially while Covid-19 still on the rise. The participants also suggested that the university should improve its Internet connectivity, especially on campus.

Providing support in terms of physical facilities for those who are in need is also suggested by the participants. The assessment portal, proctoring system, and lockdown browser must also be improved. Some policy-related issues were also suggested by the participants. They recommended that the question developers test the assessment in order for them to comprehend the technical difficulties that the candidates were facing. Issues related with online exam setting also raised and it includes avoiding "draw and upload" kind of questions.

Table 6: List of subthemes and examples of quotations for theme 3.

Subthemes		Num. of codes	Num. of quotations	Sample of quotations
1	Change back to traditional assessment	*8*	*12*	*"Hopefully, we can have face-to-face assessment. Even though I quite nervous to have face-to-face but I want it because I don't want myself to be too anxious and blur during the real pro exam. Thank you so much Dr."* D3-P1056 *"Hoping a face-to-face exam upcoming semester."* D3-P1204

2	Continue online assessment	*4*	*7*	*"Maybe continue this method for next semester as we're in the pandemic and getting exposed to public and chances of getting infected is very high."* D3-P1170 *"I prefer especially during pandemic as able to reduce meeting people."* D3-P1073
3	Provide support for physical facilities	*2*	*3*	*"online assessment is good but just survey if any students can't afford the gadget (laptop) so the campus can provide the gadgets during assessment."* D3-P1272 *"Please consider the usage of personal device if the exam venue will be at CAI lab, because the sound of typing is really disturbing and noisy since exam venue should be in silent mode.. thank you."* D3-P1052
4	Improve the Internet connection	*2*	*2*	*"Undeniably, internet connection speed and technical issues (laptop, lockdown browser) are the main concerns here than need to tackled and improved."* D3-P1305 *"Overall it is a good experience :) I love it but I just need to adapt with it and make sure there is no Internet problem again."* D3-P1221
5	Improve the assessment portal	*6*	*6*	*"Please improve the portal to avoid crash during assessment."* D3-P1071 *"Can upgrade the system so that it can allow and accept writing using digital pen like Apple pen and Samsung pen…."* D3-P1368 *"Make sure the system don't have any problems before student assess it to answer the exam questions…"* D3-P1173
6	Improve the proctoring system	*2*	*2*	*"The webcam check is the problematic one. always got stuck there. but this third sem assessment is better than previous two sem. thank you for extending time."* D3-P1024 *"Use better proctoring system."* D3-P1026
7	Improve the lockdown browser	*1*	*2*	*"Need to improve stability of lockdown browser."* D3-P1237 *"Online exam is very comfortable and good. Only need some improvement on the browsers."* D3-P1262
8	Policy related issues	*7*	*8*	*"…hope the university can add more features like highlighter and flag question if the next semester exam is still conducted online."* D3-P1362 *"Better next time have at least 1 day gap between exam day".* D3-P1013 *"Combining the MTF, SBA, SEQ, SBQ and OSCE is absurd. I know you want to minimise number of people who cannot enter for second paper and so on but exam time for about 4 HOURS is too long. Student need to compress all answer and I prefer exam like sem1 and sem2 where you divided into 2 papers".* D3-P1097

9	Settings for online assessment	3	4	*"For the online exam, it would be useful if we can flag the questions that we are unsure so we can go back to do it later."* D3-P1156 *"...better to put all question in one page and we can just scroll to go from one question to another"* D3-P1368
10	Test run	*3*	*3*	*"A kind suggestion to lecturers to undergo the same assessment questions given to students within the same time frame to confirm whether can lecturers perform well in terms of computer technicality before they set out the exam questions for students."* D3-P1342 *"...for long essay format, there should be mock essay module to practice and evaluate full capacity of long essay platform."* D3-P1369
11	Avoid "draw and upload" questions	*2*	*4*	*"The hassle of drawing picture and need to upload. Better if not to have questions that need to draw and upload."* D3-P1334 *"It would be better not to have questions that need to draw and upload. Really time consuming."* D3-P1334

DISCUSSION

The shift made the transition from traditional to online examinations inevitable. Nevertheless, post-pandemic, numerous medical schools have reverted to paper-based exams, particularly for theory papers. However, it is still used in many cases because of its advantages. Continuous improvement is imperative for online assessment platforms. Previously, technical issues raised by our students hindered the smooth progression of the assessment process, attributable to the platform's excessive usage. The shared portal for teaching, learning, and assessments posed challenges. However, to address these concerns, a dedicated server exclusively for assessment activities has been recently implemented.

Perceived Usefulness, Perceived Ease of Use and Acceptance

Based on the results, this study found that students perceived online assessment using the Moodle LMS to be useful. It serves as an alternative to traditional face-to-face assessments during the pandemic. Students also perceived that the Moodle platform was easy to use. Even though some students described their difficulties during online assessments, based on qualitative data, the students did not complain that the difficulties were caused by the learning management system (Moodle); rather, the problems were mainly caused by technical glitches such as Internet connectivity, the proctoring system, and the lockdown browser.

In terms of acceptance, most of the students preferred online assessment to the paper-based assessment with a mean score of 3.78 (1.247) and they also perceived that the online assessment is acceptable to replace the paper-based assessment with a mean score of 4.11 (1.104). These findings are consistent with those of previous studies. For example, Donovan et al. (2007) found that 88.4% of students preferred online assessments (15). Llamas-Nistal et al. (2013) found that 43 of 52 students preferred online assessment to traditional face-to-face assessment (16).

Advantages of Online Assessment

From a financial standpoint, there are significant advantages to utilizing Moodle LMS as a platform for online assessments due to its cost-effectiveness. Moodle being an open-source platform means it is freely accessible, eliminating the necessity for additional expenses. Even though it is free, most paper-based assessments can be conducted via Moodle, including multiple-choice questions (MCQs), essays, and objective structured clinical assessments (OSCEs). However, in high-stakes assessments, the integration of additional features with Moodle is essential, such as a proctoring system and a lockdown browser. These features are important to prevent candidate from cheating. Nevertheless, it is crucial to acknowledge that these specific tools come with associated costs.

Based on the feedback from participants, an online assessment using the Moodle platform is acceptable to replace the traditional face-to-face assessment. The absence of physical presence is one of the major advantages of this approach. Online assessment helps students in remote areas since they can take it anytime and anywhere, as long as they have a reliable Internet connection. This provided flexibility for students to receive exams (17).

In terms of physical and psychological aspects, online assessments were perceived as less stressful, more flexible, and more comfortable. It was also better in terms of saving time and reducing costs and energy. Online assessments have advantages in terms of saving mother nature. The test paper requires time from the teacher to correct each paper, but online assessment will save teacher's time.

Disadvantages of Online Assessment

Our quantitative data show that most candidates accept online assessments to replace traditional assessments. However, our qualitative data showed that some participants preferred traditional assessments for several reasons. For example, they worried if they can perform well in semester assessment which conducted online, but, for final exam they cannot perform due to lack of experience in face-to-face assessment as mentioned by one of the participants *"... even though I quite nervous to have face-to-face but I want it because I don't want myself to be too anxious and blur during the real pro (final) exam..."* D3-P1056.

Our qualitative data also show that some participants who perceived online assessments were not as effective as traditional face-to-face assessments. They were concerned about the limitations of the online assessments. For example, clinical skills cannot be properly assessed in online assessments. This is true. Based on our experience as vetting panels in our medical school, in order to construct assessment questions for OSCE paper, for example, we need to adapt the questions to the nature of online assessment. For example, interactive stations can no longer be used. Physical assessments and procedures cannot be performed. The OSCE paper assesses knows and knows how, rather than shows how (Figure 1). Therefore, one of the disadvantages of online assessments is the lack of interaction with patients (18).

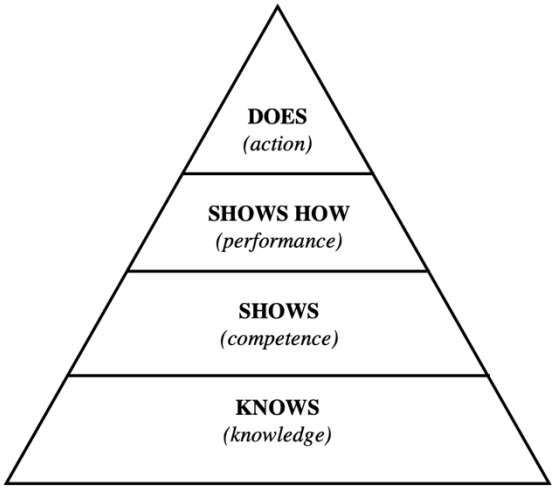

Figure 1: Miller's pyramid

Even though the online assessment seems to be feasible and acceptable for the candidates, the approach also has disadvantages that need to be considered. Clinical assessments are one of the main limitations of online assessments. How can medical schools evaluate students' performance by performing certain procedures or examining patients using an online platform? This is worth considering. Some might propose applying video conferencing software where the students can perform in front of the camera and the examiners assess them remotely. Theoretically, this appears to be convincing. The question is how can students perform without specimens, mannequins, patients, or standardize patients?

In the online assessment, examinees take the exam in their own location. Compared to the face-to-face assessment, the participants perceived that the online assessment had a lack of feeling of assessment. The participants *"... did not feel assessment pressure and no exam feeling."* (D2-P1213) and they also felt like *"... going through all of this (assessment) alone."* (D2-P1174). Some participants perceived that the online assessment made them more anxious and stressed. This is most likely due to uncertainty. There are possible technical issues related to Internet connections, servers, and devices during the assessment. Online assessments undoubtedly require a proper setup. Anything could go wrong during the assessment. This might explain why some students felt anxious and stressed during the online assessments.

This result is in line with the work of Shraim, (8) where his participants mentioned reasons for their stress, including the interruption of exams because of technical problems, their unfamiliarity with the exam platform, their lack of IT skills, and poor wording of questions.

Issues with lockdown browsers are critical because they can jeopardize students' assessment performance. If students have issues and influence marks, this becomes a major threat to assessment validity. The affected students will be penalized not because of their incompetency but because of technical issues. A recent study conducted in Pakistan found that 80% of the class was unable to launch a lockdown browser, and their computers repeatedly reloaded or rebooted (19). This should be avoided in online assessment.

Next is the focus on issues related to cheating during assessment. Logically, online assessment creates an environment in which candidates can cheat more easily than face-to-face assessments. As mentioned by some participants in our study. However, Švarc & Strnad in their study found that, there are more potential cheaters in face-to-face assessments than in online environment. They postulated that students were more careful and afraid of being tagged as potential cheaters in an online environment (20). In

terms of assessment security, we have to acknowledge that the security issues related to online assessment can potentially compromise the fairness and reliability of the assessment (21). While online assessment systems offer various security measures to minimize unauthorized behaviours, the responsibility of maintaining assessment integrity also lies in effective assessment design practices.

Suggestion for Improvement

Students generally believed that online assessment was the best solution to prevent contagion during the COVID-19 pandemic and *"... chances of getting infected is very high"* D3-P1170. At the same time, they are also *"... hoping a face-to-face exam (for) upcoming semester (assessment)"* D3-P1204. Study at the Khon Kaen University School of Medicine also found that their students preferred a traditional assessment over an online assessment (22).

In online assessments, Internet connectivity is the major backbone; hence, technical issues due to connectivity would create disturbances in the assessment (23). Therefore, it must be reliable and medical schools must ensure that the support system is good. If the students take the online assessment at their own places, and they must ensure that they are well-equipped with all the required devices. As for impoverished students who cannot buy gadgets, schools must provide support. A promising solution to address the challenges faced by students who lack the necessary facilities for online assessments at their own locations is fostering collaboration among institutions. The concept involves medical schools working together to provide their facilities, such as examination halls equipped with reliable internet connections and computers, for students residing near those institutions. However, implementing this initiative would require strong cooperation and coordination among all participating medical schools to ensure its success.

Issues related to the assessment system, including the assessment portal, proctoring system, and lockdown browser, must be thoroughly addressed. To minimize technical problems, the school should conduct a comprehensive test run prior to the actual assessment. This practice would help identify and resolve potential issues, ensuring a smoother and more reliable assessment process.

Malaysian Qualification Agency in its guidelines (24) has outlined the conditions and requirements for online assessment. They include stable internet connection with adequate speed, secure data handling throughout the process, and optimized exam materials to reduce bandwidth usage. Appropriate hardware and application platforms must also be in place to facilitate the examination.

Limitation

The findings of this study should be interpreted with caution, as there are some limitations. This is an exploratory study. As mentioned in the methodology, the researcher designed a questionnaire to evaluate perceived usefulness, perceived ease of use, and user acceptance adopted from Davis(11). However, this was not the original questionnaire. Some items were altered to suit the research objective. This study recruited students from a public university in Malaysia. Therefore, the generalizability of the findings is limited. Future research should include other medical schools as well.

Recommendation

Moodle is an open-source learning management system. It has many features that cater to the need for online student assessment. We propose the use of this freely available platform in medical schools for

student assessment. However, to ensure the security issues is improved, subscriptions to security plugins are needed especially for high-stake assessments.

To address the technical concerns highlighted by students in the study, several improvements could be made to the Moodle-based online assessment platform. A primary issue noted was unreliable internet connectivity, which led to interruptions during exams. To mitigate this problem, institutions could invest in robust, high-speed internet infrastructure on campus and offer support such as subsidized mobile data plans for students off-campus. Ensuring stable and reliable connectivity is essential for seamless assessment experiences. Additionally, the performance of the server hosting the assessment platform must be optimized. This could involve dedicating servers exclusively to assessments, preventing crashes due to excessive load from concurrent activities. Regular stress testing of these servers would help identify vulnerabilities and ensure they can handle peak traffic during assessments.

The proctoring system and lockdown browser used alongside Moodle also require refinement. Students reported issues with system crashes and compatibility problems. By improving the stability of these tools and conducting mock exams to familiarize students with their use, technical glitches could be minimized. Finally, providing real-time technical support during exams is crucial. Dedicated helplines or live chat support could help address issues promptly, alleviating student anxiety especially for students who are not on campus. By implementing these measures, institutions can improve the reliability of online assessments, enhance student confidence, and foster a more positive experience overall. (24)

CONCLUSION

Online assessments are increasingly recognized as a viable alternative to traditional face-to-face methods, offering numerous advantages that make them a compelling option for medical schools. While the feasibility and acceptability of using an open-source Moodle platform to replace traditional assessments are evident, it is important to address the challenges that may impact the validity of such assessments. It should also be acknowledged that the effectiveness of online assessments may not apply to all types of evaluations, particularly high-stakes clinical assessments.

The limitations of online assessments in evaluating clinical skills are particularly significant and warrant more critical exploration. Incorporating recommendations for different methodologies or hybrid models that blend online and in-person techniques could offer workable ways to lessen these restrictions. Medical schools must proactively address these issues to maximize the potential of online assessments while maintaining their reliability and validity.

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