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The Effectiveness of Technology-Enhanced Assessment in Malaysian Higher Education for Medical Students

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Abstract

Technology-enhanced assessment (TEA) means all types of assessments that use technological aid either online or offline, either during or after learning to improve or assess the learning process. This study assesses TEA's effectiveness and influence on medical students' academic performance in a Malaysian private university. A cross-sectional study was conducted, and convenience sampling was applied to recruit participants. A validated online questionnaire was used and the participants were required to report their demographic characteristics, academic performance before and after using TEA, and their attitudes towards the TEA. A paired t-test assessed the difference in medical students' mean CGPA before and after using TEA. Study findings showed that medical students have positive attitudes towards TEA and believe that TEA offers value to their learning. TEA was found to positively impact academic performance, and there is a significant difference in medical students' mean CGPA before and after using TEA ($p<0.05$). TEA is an effective tool that can enhance the learning process among medical students. Nevertheless, the sample studied needs to be more diverse to be able to generalize the results for all medical students in different universities and countries.

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INTRODUCTION

The COVID-19 pandemic has sped up digitalization globally (Fitri et al., 2022; Widayanti, 2021). The digital transformation trend in Malaysia has accelerated in many sectors, including the industry and academia, due to lockdown restrictions like the Movement Control Order (Abdalqader et al., 2020; Shah et al., 2020). Digitized technologies have been used in healthcare, training, and education (Babacan & Dogru Yuvarlakbas, 2022; Chen et al., 2023a; Kurniawati et al., 2023; Marzo et al., 2022). Especially for tertiary-level students, the drastic development of the higher education learning environment for the 21st century can be difficult. Education today requires innovative approaches to teaching, learning, and assessment to adapt to the changing needs of students in the digital era (Isaías & Sampson, 2020). For instance, electronic assessment (e-assessment) has become a primary focus for learning assessment, driving educators and students to adapt to new changes despite the challenges.

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Assessment involves measuring a person's capability, knowledge, or skill throughout the learning process (Sorensen, 2013). Assessment is essential to improve students' performance because it provides feedback, which is important in effective learning if appropriately applied (Irons & Elkington, 2021). For medical education, assessments are vital in producing quality doctors to provide high-quality healthcare services to increase the likelihood of desired health outcomes and contribute to sustainable development goals (Kruk et al., 2018). Therefore, appropriate assessment is crucial to evaluate the competency of clinical examination, which is much needed in 21st-century healthcare. Assessment in medical education involves technical skills and knowledge, communication skills, counseling, analytical, interdisciplinary care evidence, and the system-based care necessary to deliver healthcare (Gordon et al., 2019). This will need the assessment to be more comprehensive and able to assess the requisite attributes besides testing the skills and knowledge.

E-assessment is a sophisticated assessment strategy emphasizing the role of information technology relative to measuring student's learning. Computer technology in assessment has been introduced since the 1970s to reduce the human scoring workload. Since then, e-assessment has improved with the technologies' advancement and has become widespread in large-scale assessment due to the accuracy and convenience of the students (Olivera-Aguilar et al., 2022). Moreover, e-assessment can provide immediate feedback, which is highly beneficial due to time-saving and can increase the procedure's effectiveness and learning method (Al-Hattami, 2020). Creating policies encouraging widespread acceptance of digitalized assessments (Baah et al., 2024). E-assessment enables the creation and provision of valuable feedback to students as they participate in solving assessment tasks (Bulut et al., 2020).

Previous research has extensively examined students' perspectives and the development of e-assessment (Pathak, 2020). Studied the perspectives of forensic medicine students on e-assessment. Additionally, other studies have investigated the academic and social impacts of using e-learning and e-assessment (Coni et al., 2020; Elzainy et al., 2020). Chuo et al., (2021) evaluated the feasibility of implementing e-assessment in pharmaceutical education. Fatima et al., (2021) Implementing e-assessment for medical students in Pakistan. Overall, these studies highlight the importance of e-assessment in improving the quality of education in the health sector and underscore the challenges and benefits associated with its implementation. However, most of the research has not focused on private universities in Malaysia and the direct effects on students' academic performance. Additionally, although attitudes towards e-assessment have been explored, specific evaluations of technology-enhanced assessment (TEA) and its impact on academic performance in medical education are still lacking. Therefore, this research aimed to evaluate the medical students' attitudes towards technology-enhanced assessment (TEA) and the effectiveness of TEA in the academic performance of medical students in a Malaysian private university.

METHOD

A quantitative-based cross-sectional study was conducted during the COVID-19 pandemic. Convenience sampling was adopted in this study as this was the most appropriate and feasible sampling method during the pandemic with lockdown restrictions like the movement control order (MCO). A validated online survey was adopted from a previous study (Sorensen, 2013) and was distributed to all MBBS students at the Management and Science University, Malaysia. The participants in the study were asked to complete the questionnaire by clicking the provided link if they expressed consent for participation. This questionnaire consisted of three sections: Section A consisted of questions regarding the demographic characteristics of the participants, including gender, age, and living address; Section B comprised of the educational performance determined by the mean CGPA before and after using TEA; and Section C consisted of questions regarding the attitudes of medical students towards TEA. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to describe the demographic characteristics, attitudes towards TEA, and CGPA mean. A paired t-test assessed the difference in medical students' mean CGPA before and after using TEA. The flow chart for this study can be seen in Figure 1.

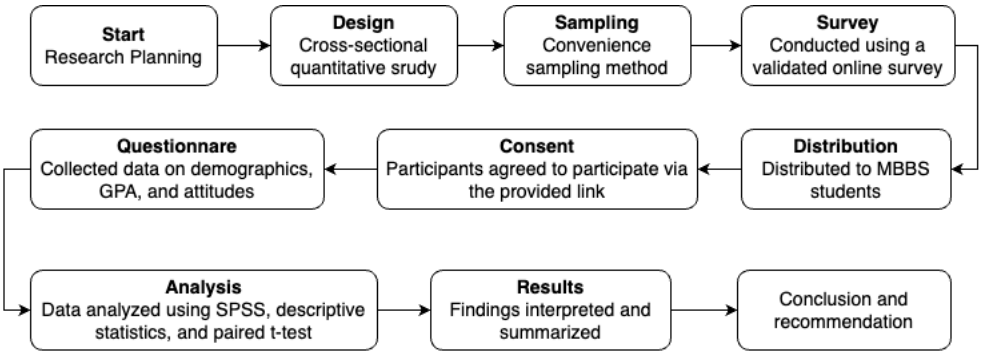

Figure 1. Research Flowchart

RESULTS

A total of 250 MBBS students participated fully in the questionnaire. The majority of respondents were female, comprising 56.8% of the sample. Regarding age distribution, the most significant proportion fell within the 20-30 age range, accounting for 56.4%, followed by those under 20 at 42.8%, and the smallest group aged 30-40 years at 0.8%. Regarding living arrangements, the highest percentage of students resided in private rental housing (51.6%), followed by those in privately owned housing (18.8%), subsidized home ownership scheme housing (17.2%), public housing (8.0%), and other types of housing (4.4%). Further details can be seen in Table 1.

In this study, a five-point scale was employed where 1 indicates "strongly disagree," 2 denotes "disagree," 3 represents "neutral," 4 signifies "agree," and 5 stands for "strongly agree." An average score of 3 suggests that medical students had no specific attitude toward a question. As presented in Table 2, the findings reveal that students exhibit overwhelmingly positive attitudes toward Technology-Enhanced Assessment (TEA). Specifically, their mean response regarding the role of e-assessment in higher education was 4.67 out of 5, indicating strong agreement with its importance. Moreover, they expressed high agreement that TEA is applicable across all modules (mean response of 4.74) and adds value to their learning experience (mean response of 4.56). They also perceive TEA as complementary to e-learning (mean response of 4.69) and appreciate its environmental benefit of reducing paper usage (mean response of 4.53). However, their preference for using computers over paper for coursework, though positive, was slightly lower (mean response of 4.36). Interestingly, students agreed on the flexibility of choosing the time and place for assessments (mean response of 3.07). These findings indicate strong student endorsement of TEA's benefits and applications in higher education, with considerations towards flexibility in assessment logistics.

Table 1. The Distribution of Respondents According to Socio-demographic Data (n=250)

Variables	**Responses N0. %**		
Gender	Male 43.2% (108)		Female 56.8% (142)
Age	< 20 years old 42.8% (107)	20-30 years old 56.4% (141)	>30-40 years old 0.8% (2)
Living address	In public housing 8.0% (20)	Subsidized home ownership scheme housing 17.2% (43)	Private rental housing 51.6% (129)
	Privately owned housing 18.8% (47)	Others 4.4% (11)	

Table 2. The Attitudes of Medical Students towards TEA

No.	**TEA**	**Mean**	**SD**
1.	E-assessment has a vital role to play in higher education.	4.67	0.59
2.	E-assessment is appropriate for all modules.	4.74	0.55
3.	My course is too complex to be dealt with by online multiple-choice questions.	2.34	0.84
4.	E-assessment can add value to my learning.	4.56	0.71
5.	E-assessment does not benefit the learning.	1.47	0.64
6.	E-assessment goes hand in hand with e-learning.	4.69	0.55

No.	TEA	Mean	SD
7.	E-assessment uses less paper, which is important to me.	4.53	0.72
8.	I would do coursework using a computer rather than on paper.	4.36	1.08
9.	I would rather do an e-assessment where I choose to than in a scheduled cluster room exam.	3.97	1.18

Table 3 presents the CGPA before and after using TEA among medical students. A paired samples t-test was used to compare the CGPA before using TEA (M=3.31, SD= 0.27) and CGPA after using TEA (M= 3.57, SD= 0.03) of 250 medical students. The paired samples test (table 4) indicates that the difference between the CGPA before and after using TEA is statistically significant ($p < 0.00$). In CGPA before and CGPA after using TEA, t= -6.88. On average, medical students' CGPA after TEA was 0.26 points higher than their CGPA before TEA.

Table 3. The CGPA Before and After Using TEA among Medical Students

Variables	Mean	N	SD
CGPA before using TEA	3.31	250	0.27
CGPA after using TEA	3.57	250	0.03

Table 4. The Difference in Medical Students' Mean CGPA Before and After Using TEA

Variables	Mean	SD	t	df	Sig. (2-tailed)
CGPA before using TEA – CGPA after using TEA	-0.26	0.61	-6.88	249	0.00

These results indicate that TEA significantly improves students' academic achievements, providing strong evidence that integrating TEA can enhance academic performance in the context of medical education. This analysis underscores the importance of technology in supporting medical institutions' learning and evaluation processes to improve the quality of education and students' learning outcomes.

DISCUSSION

Technology-enhanced assessment (TEA) is an unavoidable progress in education as it goes hand in hand with learning. The current study has been done to explore the medical students' attitudes toward TEA and to assess the effectiveness of TEA indicated by the changes in the student's CGPA after using TEA. Results indicate that the students who participated in this study have a positive attitude towards TEA, as most feel it plays a role in higher education (4.67/5). All modules (4.74/5) go hand in hand with e-learning (4.69/5) and add value to their learning (4.56/5). The e-assessment uses less paper (4.53/5), and students reported that they preferred using the computer for their coursework (4.36/5). They also like having the flexibility to choose a time and place to do the assessment (3.07/5). These findings are similar to a previous study conducted among chemical engineering students (Sorensen, 2013). Another study conducted (Attalla et al., 2021) also found that the learners' and lecturers' attitudes towards TEA are mostly positive, and external factors like the quality of the platform being utilized or the availability of resources were jointly linked to the negative attitude.

Aside from providing flexibility to the students in accessing courses at their convenience and being able to adjust the content needs and subjects to study, another important benefit of e-assessment is resource-saving, including a reduction in time and costs, allowing more opportunities for collaborative learning (Babo et al., 2023). The fast development of the Internet and the World Wide Web (WWW) has added many benefits to education, including the potential opportunities for opening new global markets for higher education institutions. Furthermore, e-assessment is also preferred by students who do not prefer face-to-face classes because of their shy personalities or having other responsibilities. Other benefits include collecting data and feedback from the students (Bryan & Clegg, 2019).

Nowadays, games are very popular, especially among the teenagers. Therefore, gamification features represent a new trend to be applied in the TEA. These features have shown strong evidence of many benefits, especially in higher education because they can increase motivation, academic achievement, and classroom dynamics (Licorish et al., 2018). It can enhance the effectiveness of TEA

in learning as the students will be more engaged and motivated by the gamification features incorporated into the TEA (Landers & Armstrong, 2017). Games like e-quizzes can also improve learning, motivation, and engagement after they become an integrated part of a traditional classroom (Zainuddin et al., 2020).

The factors that influence the effectiveness of TEA can be divided into three categories: (1) academic aspects (such as the need for quality learning materials to generate a variety of high-quality exam questions with a marking rubric); (2) technical aspects (such as the presence of a stable and secure platform, which is crucial to detect academic dishonesty and includes. the use of plagiarism detection software and biometrics for student identification); and (3) user related aspects (such as the skills of students and lecturers to apply such technology) (Attalla et al., 2021). This research results indicate that medical students' CGPA after using TEA were 0.26 points higher than their CGPA before using TEA. Previous research conducted in the University Technology MARA also indicates that the learning process through the e-assessment is significant, which further supports the influence of TEA on the CGPA (Hasan et al., 2017).

Another study conducted among medical students showed that 63% responded that the discussion during online sessions is comparable with face-to-face sessions, 72% of the students agree that there is sufficient time provided for discussion, 52.9% of the students can retain the information and ideas discussed during the online sessions, and 53% of them value the ease of use and flexibility of the online sessions while others are showing concerns regarding the issues that they may face during the online sessions such as technical issues (89.2%), the need for extra budget to ensure internet connection (72%), and distracting home environment (70.6%) (Attalla et al., 2021). This may explain the improvement of students' CGPA after practicing TEA for online learning.

The implication of this study demonstrates TEA's effectiveness in enhancing medical students' learning. Thus, opportunities exist for fellow researchers to extend the study to non-medical students. Furthermore, the fact that emerging and re-emerging infectious diseases could potentially trigger a future epidemic or pandemic (Chen et al., 2023b; Najimudeen et al., 2022) emphasizes the need to delve deeper into TEA. This study primarily examined medical students' attitudes toward TEA and its effectiveness in learning. Future work could now expand this work and explore TEA at different education levels.

LIMITATIONS

This study has several limitations, such as the use of convenience sampling, which may lead to selection bias and limit the generalizability of the findings, and the focus on only one private university in Malaysia, thus narrowing the scope. Data collection that relies on online surveys is prone to response bias, and the cross-sectional quantitative design limits the ability to establish causal relationships or explore the long-term impact of TEA on learning.

CONCLUSION

Findings from this study showed that most medical students at the Management and Science University, Shah Alam, Malaysia, have a positive attitude towards the TEA and that the students' CGPA after using TEA was 0.26 points higher than their CGPA before using TEA. In the context of technologically driven educational systems, technology-enhanced assessment can be crucial in addressing the demands created by the digital era. Robust policy design and implementation are essential to support the introduction of technology-enhanced assessment as an innovation tool in 21st-century education and digital learning. For further research, it is recommended to delve deeper into the factors influencing medical students' positive attitudes towards Technology-Enhanced Assessment (TEA) and to explore their direct experiences with TEA, including challenges and benefits during the learning process. The study could expand to compare TEA effectiveness across different disciplines and educational contexts while also investigating its impact on active learning and problem-solving skills in digital learning environments. Additionally, this research could formulate practical guidelines for educational policies that support TEA's widespread and effective implementation.

AUTHOR CONTRIBUTIONS

SMA and HWJC conducted a study on designing and drafted an article. SR, KK, and MA performed data collection. JI, NN, and, JJ performed data analysis. All authors read and approved the final draft of the article.

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