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Proficiency, Facilitators and Barriers to Computer-Based Examination among Postgraduate Students at the University of Port Harcourt

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ABSTRACT

Background: The globalization of higher education, driven by increased integration of Information and Communication Technologies (ICT), has accelerated the adoption of computer-based examinations (CBE). However, limited evidence exists on postgraduate students' proficiency, facilitators, and barriers to effective CBE in sub-Saharan Africa. This study assessed these dimensions at the Africa Centre of Excellence in Public Health and Toxicological Research (ACE-PUTOR), University of Port Harcourt, Nigeria.

Methods: An analytic cross-sectional design was used with a convenience sample of current and past students from the 2020/2021 to 2023/2024 cohorts. A validated structured questionnaire (reliability coefficient: 0.71–0.90), informed by the Technology Acceptance Model and UTAUT, captured perceived proficiency (8 items), facilitators, and barriers (5 items each across technical, academic, and organizational domains). Likert-scale responses were converted to percentage scores. Data were analyzed using descriptive statistics, paired sample t-tests, Spearman's correlation, force field analysis, and generalized linear regression (SPSS v29; significance set at $p \leq 0.05$).

Results: Among 137 respondents, most were aged 41–50 (35.0%), female (75.2%), married (81.8%), nurses (71.5%), and Nigerians (77.4%). Laptop use for CBE was high (90.5%). Mean scores were: proficiency 67.5±23.0, facilitators 63.8±19.2, and barriers 40.1±20.6. Only the barrier scale met normality (p=0.257). There was a positive force field score of 23.9 (95% CI: 18.3–29.1, p<0.001). Proficiency in CBE correlated strongly with facilitators (r_s=0.73, p<0.001) and weakly negatively with barriers (r_s= –0.27, p=0.001).

Conclusion: Psotgraduate students showed moderate CBE proficiency, reinforced by favourable facilitators. Targeted strategies are needed to reduce barriers and enhance digital assessment readiness

Keywords: Computer-based examination, CBE, proficiency, barriers, facilitators, postgraduate students, ACE-PUTOR, UNIPORT

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INTRODUCTION

The world has transitioned into a digital age due to advancements in Information and Communication Technology (ICT) and its widespread availability.[1] The globalization of education, particularly in higher institutions, has accelerated through increased adoption of ICT as both an instructional and assessment tool, gaining greater relevance and prominence (2). The COVID-19 pandemic in 2020, which led to widespread lockdowns, significantly amplified the integration of digital technologies into teaching and learning systems [1,3,4]. This period saw a rapid shift from traditional paper-based methods to digital learning and assessments, which have since become the new norm. As a result, educational systems have transformed, influencing both teaching delivery and student assessment, and facilitating the broader transition from the technology age to the knowledge age [5].

In today's educational landscape, paper-based examinations are increasingly seen as less practical and more susceptible to several limitations. Challenges such as human errors in marking, misplacement of scripts, impersonation, and examination malpractice undermine their integrity and reliability. Furthermore, organizing paper-based exams involves significant logistical and financial burdens, including printing, transport, and secure storage of materials. These issues often result in delays in grading and result dissemination, leading to frustration among students and faculty. These persistent challenges underscore the need for more efficient, secure, and scalable assessment methods [1, 6, 7]

Examinations remain a vital component of the learning process, serving to evaluate student knowledge and motivate academic achievement. Although traditionally conducted via paper-based formats, the shift towards computer-based examinations (CBEs) has been catalyzed by evolving educational trends and the need for improved assessment tools (1). Also referred to as computer-based testing (CBT), computer-assisted testing (CAT), or computer-based assessment (CBA), CBEs use digital platforms to deliver exam content through standalone or networked devices (5). They offer valuable feedback to both instructors and learners, enhancing the overall teaching and learning experience [3, 4, 8, 9].

CBEs offer numerous advantages, including enhanced reliability, transparency, efficiency, reduced administrative costs, improved scalability, and immediate feedback. They also allow flexibility in time and location for test-takers, contributing to greater inclusivity and accessibility [3, 8, 10, 11, 12, 13, 14]. However, CBEs are not without limitations and challenges such as limited test time, digital anxiety, technical glitches, difficulty navigating platforms, and stress associated with potential disruptions [1, 7, 10, 15]

Postgraduate students often face additional pressures due to the need to balance academic, professional, and personal commitments. Factors such as technological proficiency, time management, access to digital infrastructure, and stress levels are particularly relevant in the context of CBEs. This is especially so where many of these postgraduate students are older and digital immigrants who have adopted digital technology later in life (16) when constract is made with undergraduate students who are largely digital natives, being born into the era of widespread use of internet and digital technology, making them naturally fluent in its use from an early age [17].

The theoretical underpin for this research are the Technology Acceptance Model (TAM) (18) which underscores the relevance of perceived usefulness (PU) and perceived ease of use (PEOU), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (19) which focus on performance expectancy, effort expectancy, social influence, and facilitating conditions. These models are useful in understanding user acceptance and utilization of digital technologies in education. The conceptual framework that guided this study is illustrated in Figure 1 shows the interplay of factors associated with postgraduate students' performance in computer-based examination.

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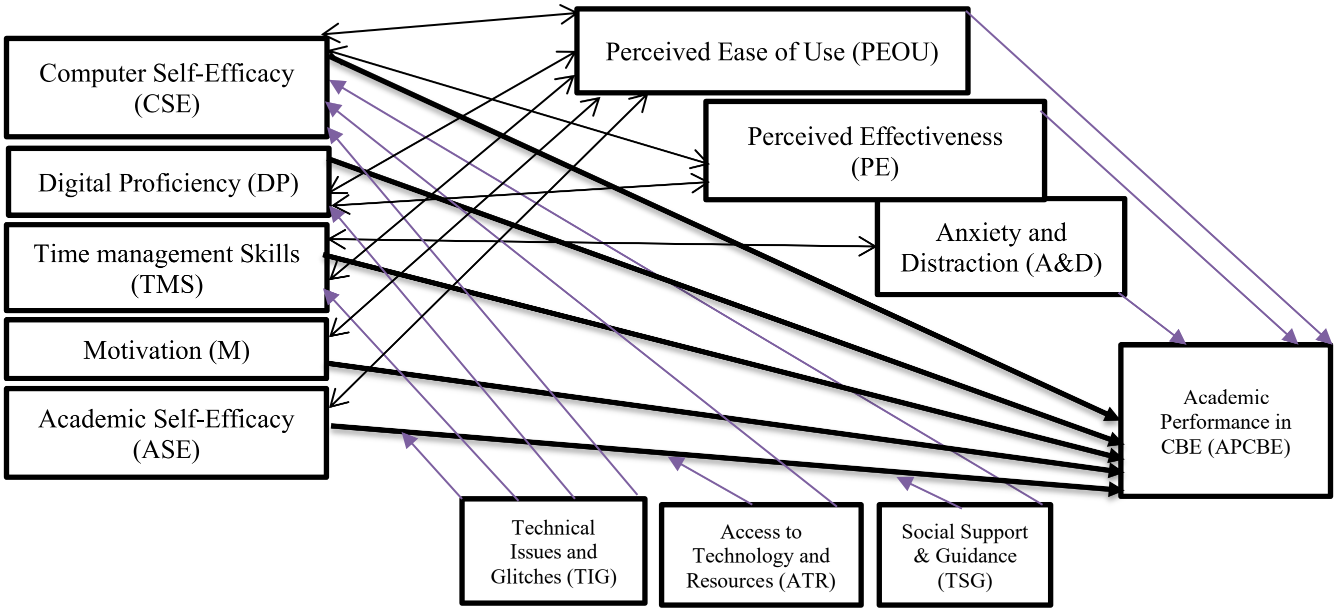

Figure 1: Conceptual framework for the study

Despite the growing use of computer-based assessments in postgraduate education, limited research exists on how these factors impact postgraduate students' performance in such exams. This study explores postgraduate students' perceived proficiency in computer-based examinations, along with the facilitators and barriers that affect their performance, using students enrolled in the Research Methodology course at the Africa Centre of Excellence in Public Health and Toxicological Research in the University of Port Harcourt as a case study.

METHODS

Design

This study employed an analytic, cross-sectional survey design

Study area

The study was conducted across varying postgraduate programmes with the postgraduate student population at the Africa Centre of Excellence in Public Health and Toxicological Research (ACE-PUTOR), University of Port Harcourt (UNIPORT), Rivers State, Nigeria. ACE-PUTOR is a regional Centre established to promote collaboration and interdisciplinary research; improve the practice of public health, biochemistry, toxicology, and nursing; produce cutting – edge research. The Centre was established in November 2018 and commenced academic activities with the 2018/2019 admission cohort in June 2019. Since then, the Centre has run an uninterrupted academic and research calendar and has hosted students from several countries in Africa.

Study population

Participants were drawn from postgraduate students enrolled in the 2020/2021, 2021/2022, 2022/2023, and 2023/2024 academic sessions. The sample population consisted of 484 students, 130 doctoral-level (PhD) students, and 354 master level (MSc) students.

Sample size and Sampling Technique

All postgraduate students enrolled in 2020/2021, 2021/2022, 2022/2023, and 2023/2024 academic years formed the sample population for this study. A convenience sampling technique was used to select participants who were willing and able to complete the electronic survey sent across to all within the sample frame. The sample size was determined using the Finite Population Sample Size Formula (20), which allows for exact calculation and inferences of a finite population of the student cohorts with 95% confidence and 5% margin of error.

$$n = (Z^2 x N x p x (1 - p))/((N - 1) x E^2 + Z^2 x p x (1 - p))$$

where: n = Sample size, N = Population size (484), Z = Z-score (depends on the confidence level, e.g., 1.96 for 95% confidence), P = Estimated proportion of the population (usually 0.5 when unknown to calculate optimum sample size), e = Margin of error (e.g., 0,005 for 5%)

Data collection

The primary data were obtained directly from the study participants through a structured questionnaire. The research instrument was developed based on an extensive review of relevant literature and was subjected to expert evaluation to establish content and face validity. These reviews were conducted by professionals in information and communication technology (ICT) and higher education. To ensure the validity and comparability of students' performance scores, the study focused on a common course taken as a computer-based examination (CBE): "Research Methods" for doctoral (PhD) students and "ICT and Research Methods" for Master of Science (MSc) students. This approach provided a consistent benchmark for assessing performance across the study population

Instrument validation

The questionnaire was pilot tested on 10 respondents to check clarity, applicability, and the time needed to complete the questionnaire. The respondents were included in the study since no modifications were made to the survey. The internal consistency of the research instruments used in this study was assessed by calculating Cronbach's alpha (α) reliability coefficients for each scale. The Cronbach's alpha results yielded values within the range of 0.708 - 0.830. This demonstrated adequate to excellent internal consistency, suggesting that the items were sufficiently homogeneous and reliably measured the underlying construct.

Variables

The dependent variable in this study is the proficiency of postgraduate students in computer-based examinations (CBE) in Research Methodology—a common course undertaken by all masters and doctoral candidates in the institution.

The list of postgraduate students by program and academic year were obtained from institutional records using a standardized data extraction form. The questionnaire used for data collection was designed to align with the research objectives with constructs identified from existing literature. The questionnaire consists of two parts (1 & 2) and five-point Likert scale was employed to address the research questions, primarily covered in Part 2 which has 3 sections covering, performance, facilitators and barriers. Responses ranged from Strongly Agree (5 points), Agree (4 points), Neutral (3 points), Disagree (2 points), to Strongly Disagree (1 point).

Part 1 captures the socio-demographic profile and academic performance of respondents, including age, gender, country of residence, academic level and year, program of study, marital status, employment status, and work experience.

Part 2 is divided into three sections:

- Section 1 includes 8 items on perceived proficiency in CBE.
- Section 2 includes 15 items on facilitators of CBE performance, categorized into technical (e.g., digital devices, LMS, internet access, CBE platform, technical support), academic (e.g., preparation, time management, question format, motivation), and organizational (e.g., student-teacher interaction, exam timing, clarity of instructions).
- Section 3 includes 15 parallel items identifying technical, academic, and organizational barriers to CBE performance.

The survey was administered via SurveyMonkey, and responses were automatically forwarded to the researcher's email. Upon survey closure, the data were exported in spreadsheet format before finally exporting to Statistical Package for Social Sciences (SPSS) version 29 for analysis.

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Data analysis

Data were organised and analysed using the Statistical Package for the Social Sciences (SPSS) version 29. The 5-point Likert response ratings were transformed into percentages using the formula: using $S_T = (S_T - S_{min}) / (S_{Max} - S_{Min}) \times 100$ where S_T is the transformed score, $S_{Min} = 1$ and $S_{Max} = 5$.

The Shapiro-Wilk test was conducted to assess the normality of key variables related to postgraduate students' performance in computer-based examinations. A p-value < 0.05 indicated non-normality. Skewness and kurtosis were also evaluated to examine data distribution. Descriptive and inferential statistics were conducted - Descriptive statistics included means, standard deviations, and frequencies. Inferential analyses involved Spearman's rank correlation and generalised linear regression to examine relationships, strengths, and directions between variables. The force field analysis approach used to quantify the balance between mean summated scores of facilitators and barriers to postgraduate students' performance in CBE is an appropriate approach to visualise and statistically interprete opposing influences on behavioural outcomes (21). While the force field analysis effectively captures the net directional influence between facilitators and barriers, it may oversimplify complex interactions unless complemented by qualitative insights or multivariate modeling (22). The generalised linear regression is suitable for continuous response variable which may not meet the assumptions for normality and linear relationship between response and predictor variables. The predictor variables may be categorical (factors) and/or contineous (covariates). The Spearman's ranked correlation coefficient (r_s) as a non-parametric analysis, measured the strength of bivariate associations: very weak (0–0.19), weak (0.20–0.39), moderate (0.40–0.59), strong (0.60–0.79), and very strong (0.80–1.00). A p-value ≤ 0.05 was considered statistically significant.

Ethical Approval

Ethical approval was sought from the University of Port Harcourt Institutional Review Board. Subjects were informed about the purpose of the study, their rights, and the confidentiality of their responses, and their consent was obtained. The participants in the study were assured that there was no potential harm, and all information collected from them would be kept confidential to protect their identities. Additionally, permission was sought from the ACE-PUTOR Administrator to disseminate the questionnaire among the students.

RESULTS

Out of the targeted 215 postgraduate students, only 137 completed the questionnaire, representing a response rate of 63.7%.

Table 1: Respondents Background Characteristics

Variable	Category	Frequency	Percentage
Age	30 years or less	2	1.5
	31-40	45	32.8
	41-50	48	35.0
	51 and above	42	30.7
Gender	Male	34	24.8
	Female	103	75.2
Marital Status	Single	21	15.3
	Married	112	81.8
	Divorced/Widowed	4	2.9
Academic Level	MSc	85	62.0
	PhD	52	38.0
Training Division	Nursing	98	71.5
	Public Health	28	20.4
	Toxicology	11	8.0
Academic Year of Enrolment	2020/2021	25	18.2
	2021/2022	17	38.0

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	2022/2023	30	21.9
	2023/2024	65	47.4
Years of Experience	1-6	11	8.0
	7-18	61	44.5
	19.30	49	35.8
	31 and above	16	11.7
Country of Residence	National Students	106	77.4
	International Students	31	22.6
Digital device mainly used for exam	Smart Phone	10	7.3
	Desk Computer	2	1.5
	Laptop	124	90.5
	iPad	1	0.7
Longest exposure in years to digital device	1-5	30	21.9
	6-15	76	55.5
	16 and above	31	22.6

Table 2: Normality Assessment of Dependent Variables (Shapiro Wilk Test)

Scale	Median	Mean (SD)	Shapiro Wilk Statistics	Df	p-value	Skewness (SE)	Kurtosis (SE)
Proficiency in CBE	71.88	67.54(23.04)	0.936	137	.000	-0.82(0.21)	0.27(0.41)
Technical Facilitators	70.00	65.95(23.58)	0.955	137	.000	-0.58(0.21)	0.22(0.41)
Academic Facilitators	70.00	67.30(22.38)	0.939	137	.000	-0.82(0.21)	0.34(0.41)
Organizational Facilitators	60.00	58.21(19.09)	0.982	137	.063	-0.33(0.21)	0.30(0.41)
Summated Facilitators	65.00	63.82(19.25)	0.966	137	0.002	-0.67(0.21)	0.47(0.41)
Technical Barriers	40.00	39.60(24.07)	0.966	137	.002	0.41(0.21)	-0.32(0.41)
Academic Barriers	40.00	40.07(23.28)	0.978	137	.024	0.19(0.21)	-0.48(0.41)
Organizational Barriers	40.00	40.73(24.79)	0.972	137	.006	0.30(0.21	-0.54(0.41)
Summated Barriers	40.00	40.13(20.58)	0.988	137	0.257	0.17(0.21)	-0.32(0.41)

Note: df = degree of freedom,
Sig. (significance) values less than 0.05 indicate a significant deviation from normality.

The results presented in Table 2 above revealed median and mean scores of all the barriers and facilitators of CBE as well as findings from the test for Normality. Several of the dependent variables did not follow normal distribution except for organizational facilitators ($W = 0.982$, $p = 0.063$) and summated scores of the barriers ($W = 0.988$, $p = 0.257$).

Table 3. Forced Field Analysis of Facilitators and Barriers to CBE

Aspect	Facilitation mean weight	Barriers mean weight	Mean difference (95%CI)	Paired sample t-test (df = 136)	p-value
Technical	65.95	39.60	26.35 (19.94, 32.76)	8.12	0.000
Academic	67.30	40.07	27.23 (20.98, 33.48)	8.62	0.000
Organisational	58.21	40.73	17.48 (11.78, 23.19)	6.06	0.000
Entire scale	63.82	40.13	23.68 (18.32, 29.05)	8.73	0.000

CI: Confidence Interval
Note higher mean indicates stronger force (either facilitating or barrier and mean difference shows the direction of the force field analysis)

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Table 3 presents the results of the force field analysis and paired samples t-tests, conducted to assess the mean differences between facilitator and barrier forces across the technical, academic, and organizational dimensions of computer-based examinations (CBE), as well as for the overall scale. The findings demonstrate statistically significant disparities across all domains, consistently favouring facilitator forces. In the technical domain, the mean score for facilitators (M = 65.95) substantially exceeded that of barriers (M = 39.60), resulting in a significant mean difference of 26.35, 95% CI [19.94, 32.76], $t(136) = 8.12$, $p < .001$. Similarly, in the academic domain, facilitators recorded a mean score of 67.30 compared to 40.07 for barriers, yielding the largest mean difference among the three domains (27.23), 95% CI [20.98, 33.48], $t(136) = 8.62$, $p < .001$. For the organizational domain, the facilitators' mean score (58.21) also significantly surpassed that of the barriers (40.73), with a mean difference of 17.48, 95% CI [11.78, 23.19], $t(136) = 6.06$, $p < .001$. On the aggregate scale, the overall mean for facilitator forces (M = 63.82) was markedly higher than that for barrier forces (M = 40.13), producing a significant mean difference of 23.68, 95% CI [18.32, 29.05], $t(136) = 8.73$, $p < .001$.

Table 4. Spearman's' Rank Correlation of association between perceived performance in CBE and facilitator/barriers

Variable	r_s (95%CI	p-value	Strength of Association
Facilitator			
Technical	0.69 (0.56, 0.79)	<0.001	Strong positive
Academic	0.67 (0.55, 0.77)	<0.001	Strong positive
Organisational	0.59 (0.44, 0.71)	<0.001	Strong positive
Total facilitator scale	0.73(0.58, 0.83)	<0.001	Strong positive
Barriers			
Technical	-0.28 (-0.42, -0.08)	0.002	Weak negative
Academic	-0.30 (-0.46, -0.11)	<0.001	Moderate negative
Organisational	-0.11 (-0.03, 0.09)	0.193	Weak negative
Total barrier scale	-0.27(-0.44, -0.07)	0.001	Weak negative

Table 4 summarizes the results of Spearman's rank-order correlation analysis conducted to examine the association between perceived proficiency in computer-based examinations (CBE) and perceived facilitators and barriers across technical, academic, and organizational domains. The findings revealed statistically significant strong positive correlations between perceived proficiency and all facilitator domains. Notably, postgraduate students perceived proficiency showed a strong correlation with the overall facilitator scale, $r_s = .73$, 95% CI [.58, .83], $p < .001$. Within specific domains, strong positive correlations were observed for the technical aspect ($r_s = .69$, 95% CI [.56, .79], $p < .001$), academic aspect ($r_s = .67$, 95% CI [.55, .77], $p < .001$), and organizational aspect ($r_s = .59$, 95% CI [.44, .71], $p < .001$). These results suggest that higher perceived proficiency in CBE is strongly aligned with the presence of facilitating factors across all assessed domains. Conversely, negative correlations were observed between perceived digital proficiency and perceived barriers. A moderate negative correlation was found for academic barriers, $r_s = –.30$, 95% CI [–.46, –.11], $p < .001$, while weak negative correlations were noted for technical barriers, $r_s = –.28$, 95% CI [–.42, –.08], $p = .002$, and the overall barrier scale, $r_s = –.27$, 95% CI [–.44, –.07], $p = .001$. However, the correlation between organizational barriers and perceived proficiency was not statistically significant, $r_s = –.11$, 95% CI [–.03, .09], $p = .193$. These results critically highlight that while perceived proficiency is positively linked with facilitators, it is inversely related to barriers—particularly in the academic and technical domains

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Table 5. Factors associated with perceived proficiency in CBE

Variable	Category	Perceived proficiency – mean (SD)	Bivariate analysis		Multivariate analysis	
			B (95%CI)	p-value	B (95%CI)	p-value
Age	≤30 years	50.00 ± 53.03	-18.9(-51.3,13.5)	0.253	6.2(-24.6, 36.9)	0.693
	31–40	67.78 ± 25.55	-1.1(-10.7, 8.5)	0.819-	1.3(-7.3, 10.0)	0.761
	41–50	66.86 ± 22.46	-2.0(-11.5, 7.4)	0.673	2.4(-4.2, 9.1)	0.471
	51+	68.90 ± 19.90	-		-	
Gender	Male	71.05 ± 23.78	6.7(-4.2, 13.5)	0.302	-5.5(-12.2, 1.3)	0.112
	Female	66.38 ± 22.79	-		-	
Marital Status	Single	71.28 ± 22.07	4.1(-20.4, 28.6)	0.743	1.5(-13.7, 16.8)	0.843
	Married	66.85 ± 23.45	-0.3(-23.2, 22.5)	0.977	-2.7(-17.0, 11.6)	0.712
	Divorced/Widowed	67.19 ± 18.66	-		-	
Academic Level	MSc	65.40 ± 22.35	-5.6(-13.5, 2.2)	0.161	-4.0(-9.5, 1.4)	0.145
	PhD	71.03 ± 23.94	-		-	
Training Division	Nursing	66.49 ± 23.68	-1.7(-16.0, 12.6)	0.816	-0.3(-10.4, 9.9)	0.959
	Public Health	70.98 ± 21.07	2.8(8.1, -13.2)	0.731	3.3(-7.4, 14.0)	0.543
	Toxicology	68.18 ± 23.13	-		-	
Years of Experience	1–6 years	64.49 ± 31.41	-8.0(-25.5, 9.6)	0.372	-4.2(-18.5, 9,1_	0.506
	7–18 years	68.70 ± 23.53	-3.8*-16.3, 8.8)	0.557	6.6(-3.1, 16.4)	0.182
	19–30 years	65.18 ± 21.84	-7.3(-20.2, 5.6)	0.268	-1.6(-10.3, 7.1)	0.719
	31+ years	72.46 ± 18.90	-		-	
Academic Year	2020/2021	67.63 ± 23.16	-2.3(-12.7, 8.1)	0.661	1.7(-5.1, 8.5)	0.620
	2021/2022	71.51 ± 22.67	1.6(-10.5, 13.6)	0.800	-1.5(-9.5, 6.4)	0.707
	2022/2023	60.00 ± 22.03	-10.0(-19.7, -0.2)	0.046	-4.2(-10.6, 2.1)	0.707
	2023/2024	69.95 ± 23.28	-		-	
Student country	National	66.01 ± 23.69	-6.8(-15.9, 2.3)	0.145	-3.6(-10.6, 3.5)	0.319
	International	72.78 ± 20.14	-		-	
Device Used for CBE	Smartphone	60.31 ± 26.64	47.8(1.9, 93.7)	0.041	-0.5(-42.7, 41.8)	0.983
	Desktop Computer	59.38 ± 4.42	46.9(-6.7, 100.5)	0.087	-2.4(-47.7, 42.9)	0.916
	Laptop	68.70 ± 22.44	56.2(12.2, 100.2)	0.012	1.8(-38.6, 42.2)	0.929
	iPad	12.50 (0)	-		-	
Exposure Duration (Years)	1–5	61.77 ± 24.67	-13.1(-24.4, -1.8)	0.023	-6.7(-14.3, 0.9)	0.082
	6–15	66.82 ± 23.07	-8.1(-17.5, 1.3)	0.092	-3.9(-10.1, 2.2)	0.207
	>15	74.90 ± 19.92	-		-	
Technical F			0.7(0.6, 0.8)	0.000	0.4(0.2, 0.6)	0.000
Academic F			0.7(0.6, 0.9)	0.000	0.4(0.2, 0.6)	0.000
Organisational F			0.7(0.6, 0.9)	0.000	0.1(-0.1, 0.3)	0.151
Technical B			-0.2(-0.3, -0.1)	0.027	-0.1(-0.2, 0.1)	0.191
Academic B			-0.2(-0.4, -0.1)	0.009	0.1(-0.1, 0.2)	0.411
Organisational B			-0.1(-0.2, 0.1)	0.381	0.1(-0.1, 0.2)	0.274

F- facilitator, B - barrier

Table 5 presents the analysis of factors associated with perceived proficiency in computer-based examinations (CBE), identifying technical and academic facilitators as consistent predictors of performance in both bivariate and multivariate analyses. In the bivariate analysis, each unit increase in organizational facilitators was associated with a 0.7-unit increase in perceived proficiency (95% CI: 0.6–0.9; $p < .001$). However, after adjusting for potential confounders in the multivariate model, this relationship was no longer statistically significant ($B = 0.1$; 95% CI: –0.1 to 0.3; $p = .151$). Technical barriers

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(B = –0.2; 95% CI: –0.3 to –0.1; p = .027) and academic barriers (B = –0.2; 95% CI: –0.4 to –0.1; p = .009) were significantly associated with lower perceived proficiency only before adjustment for confounders. Among personal factors, only the use of a laptop for CBE showed a significant positive effect on proficiency compared to using an iPad (B = 56.2; 95% CI: 12.2–100.2; p = .012). Furthermore, students with more than 15 years of digital device experience performed significantly better than those with five years or less of exposure (B = –13.1; 95% CI: –24.4 to –1.8; p = .023).

DISCUSSION

Findings reveal a critical imbalance between facilitator and barrier forces across all assessed dimensions of computer-based examinations (CBE), with facilitator forces consistently and significantly stronger. The largest mean difference was observed in the academic domain, suggesting that academic support structures such as clear guidelines, training, and curriculum alignment, play a pivotal role in enhancing students' readiness and confidence in CBE. This aligns with findings from Kim et al [23], who emphasize that academic preparedness is a key determinant of positive student experiences in digital assessments.

The technical domain also showed a substantial facilitator-barrier gap, underscoring the importance of infrastructure, platform usability, and technical support. This corrobrorates with the findings from an earlier study [10]. This observation is a pointer that overcoming technical obstacles is fundamental to successful CBE implementation. Although the organizational domain showed the smallest mean difference, the statistical significance indicates that logistical and administrative facilitators such as scheduling, communication, and exam management still contribute meaningfully to the overall CBE experience.

The overall mean difference further emphasizes that facilitators substantially outweigh barriers, reinforcing the effectiveness of current enabling factors while also identifying critical areas for improvement. These findings suggest that targeted interventions to reduce barriers, especially in academic and technical areas, could significantly improve the perceived efficacy and adoption of CBE systems among postgraduate students. There was a strong positive association between perceived proficiency in computer-based examinations (CBE) and facilitators across technical, academic, and organizational domains. The highest correlation was observed with the overall facilitator scale (r_s = .73), suggesting that as enabling factors increase, so does students' confidence and perceived ability in using CBE platforms. This aligns available evidence indicating that adequate technical infrastructure, academic preparedness, and institutional support enhance user experience and performance in digital assessments [10, 23]

Specifically, technical facilitators (r_s = .69) and academic facilitators (r_s = .67) showed particularly strong associations, highlighting the importance of user-friendly systems and adequate training in building CBE proficiency (24, 25). Conversely, perceived barriers—especially academic (r_s = –.30) and technical (r_s = –.28) were negatively correlated with proficiency, supporting evidence that challenges such as poor guidance or unreliable systems hinder performance and reduce digital confidence [26, 27]

Interestingly, organizational barriers did not show a significant association, possibly indicating that structural issues may have less direct influence on perceived proficiency in CBE compared to more immediate user-level and academic factors (28). Essentailly, enhancing facilitators and reducing academic and technical barriers will constitute effective strategies for improving students' digital proficiency and success in CBE environments.

The factors associated with performance in CBE in this study underscore the influence of technical and academic facilitators and barriers, as well as select personal digital experience variables, on perceived proficiency in CBE. Consistent with existing literature, these facilitators remained statistically significant in both bivariate and multivariate analyses, reinforcing their foundational role in the successful implementation and user confidence in digital assessment platforms (10, 29). Technical facilitators are repeatedly cited as essential for promoting user engagement and reducing anxiety in digital examination environments (24). Likewise, academic facilitators are pivotal for enhancing test-taking confidence and proficiency [23, 25]

Interestingly, although organizational facilitators were significantly associated with perceived proficiency in the bivariate analysis, this association was attenuated and

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became statistically non-significant after controlling for other variables. This suggests that while institutional support contributes to the examination experience, its impact may be indirect or mediated through more proximal factors like technical readiness or academic preparedness.[28] The diminishing effect in the multivariate model aligns with studies that stress the need for a holistic approach to digital examination readiness, where organizational structures serve as enablers but do not independently guarantee success. [30]

Conversely, both technical and academic barriers showed significant negative associations with perceived proficiency in CBE, even after adjusting for confounders. These findings are aligned with prior studies that report technical difficulties (e.g., system errors, device incompatibility) and academic obstacles (e.g., lack of clarity in instructions or insufficient feedback mechanisms) as key deterrents to effective CBE use (26, 27). The persistence of these barriers in the multivariate model highlights their critical influence and underscores the importance of addressing them systematically.

Among personal factors, the use of a laptop over an iPad was found to significantly enhance perceived proficiency, suggesting that device familiarity, keyboard ergonomics, and screen size may affect user performance and confidence [31]. This is corroborated by studies that found students perform better on devices they commonly use for academic tasks, particularly when these devices are more compatible with examination platforms [32].

Additionally, greater digital exposure specifically more than 15 years of experience using digital devices was positively associated with perceived proficiency compared to limited exposure (≤5 years). This finding is consistent with digital literacy literature, which shows that sustained exposure to digital environments improves users' adaptability, confidence, and efficacy in using technology for learning and assessment (16, 17, 33). This has implications for the design of interventions targeting less digitally experienced students, such as through preparatory orientation or digital skill-building workshops.

Implications of the findings

The findings from this study have important implications for future research, practice, and policy on computer-based examinations (CBE). The consistent dominance of facilitator forces across all domains highlights the critical importance of strengthening technical infrastructure, academic support, and organizational logistics to sustain positive user experiences. The dominance of facilitator forces over barrier forces in all evaluated aspects of CBE implementation should be reassuring to institutional actors who should consider these barriers as though formidable, are not insurmountable in attempts to marshal out interventions that will improve students' performance in CBE.

Strong positive correlations between perceived proficiency and facilitators reinforce the need for CBE environments that are not only technically sound but also pedagogically and administratively supportive. Conversely, the negative associations with barriers particularly in academic and technical aspects indicate that unresolved challenges may undermine the postgraduate students' confidence and performance.
Institutions of higher learning should prioritize capacity building through digital literacy training, device accessibility, and continuous academic orientation especially for older students who are digital migrants. The institutional policy should mandate minimum standards for CBE platforms, training requirements for users, and equitable access to digital resources.

Future researchers should consider longitudinal designs to assess how sustained exposure, training, and system improvements influence long-term proficiency and performance. Further investigation into the specific organizational practices that facilitate or hinder proficiency especially since organizational barriers showed no significant correlation could guide more targeted interventions.

Ultimately, aligning policy and institutional practice with evidence-based facilitators, while addressing identified barriers, is essential to optimizing the effectiveness, acceptance, and equity of CBE systems in higher education.

Conclusion

The findings shows that facilitator forces particularly academic and technical significantly enhance perceived proficiency in computer-based examinations (CBE), while barriers in these same domains hinder

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performance. The strong positive correlations between proficiency and facilitators, along with negative correlations with barriers, underscore the importance of creating an enabling environment for successful CBE implementation. The observed consistent predictive value of academic and technical factors suggests that institutional efforts should prioritise digital infrastructure, training, and academic support Policy and practice should focus on reducing barriers, enhancing facilitator structures, and addressing digital inequities, especially for less experienced users. Future research should explore long-term impacts of digital preparedness and the evolving role of organizational support. Overall, optimising CBE systems requires a coordinated approach grounded in evidence-based practice, inclusive policy, and continuous evaluation to ensure equitable and effective CBE implementation in higher institution of learning.

REFERENCES

1. Khan MA, Vivek V, Khojah M, Nabi MK, Paul M, Minhaj SM. Learners' perspective towards e-exams during COVID-19 outbreak: Evidence from higher educational institutions of India and Saudi Arabia. International Journal of Environmental Research and Public Health. 2021 Jun 17;18(12):6534. https://doi,org/10.3390/ijerph18126534
2. Bamigboye OO, Olusesan AA. An analysis on impact of social media for learning in Eastern Cape Universities, South Africa. International Journal of Educational Sciences. 2017 Jun 3;17(1-3):69-75. https://doi.org/10.1080/09751122.2017.1305755
3. Eltahir ME, Alsalhi NR, Al-Qatawneh SS. Implementation of E-exams during the COVID-19 pandemic: A quantitative study in higher education. Plos one. 2022 May 20;17(5):e0266940. . https://doi.org/10.1371/journal.pone.0266940
4. Emdas R. Online learning during COVID-19 pandemic, and possibility of adopting computer-based test. International Journal of Computer Science & Information Technology (IJCSIT) Vol. 2021 Aug;13. https://doi.org/10.5121/ijcsit.2021.13401
5. Ajinaja M. The design and implementation of a computer-based testing system using component-based software engineering. IJCST. 2017 Jan;8(1):58-65.
6. Khoshsima H, Toroujeni SM. Transitioning to an alternative assessment: Computer-based testing and key factors related to testing mode. European Journal of English Language Teaching. 2017 Feb 3. https://doi.org/10.5281/zenodo.268576
7. Oladimeji OF, Mwuese BC. Computer based test: panacea to undergraduate students' performance in Olabisi Onabanjo University, Ogun State, Nigeria. Educational Research. 2018;9(3):50-7. https://doi.org/10.14303/er.2018.219
8. Alyahya D, Almutairi N. The Impact of Electronic Tests on Students' Performance Assessment. International Education Studies. 2019;12(5):109-19. https://doi,org/105539/ies.v12n5p109
9. Daramola FO. Impact of computer-based test In Nigeria tertiary institutions: A theoretical view. International Journal of Innovative Technology Integration in Education. 2017;1(1):109-16.
10. Alruwais N, Wills G, Wald M. Advantages and challenges of using e-assessment. International Journal of Information and Education Technology. 2018 Jan;8(1):34-7.
11. Amer ME. Effectiveness of using electronic exams in assessment in Saudi Universities: Empirical study. International Journal of Educational Technology and Learning. 2020;8(2):61-9. https://doi.org/10.20448/2003.82.61.69
12. Bloom TJ, Rich WD, Olson SM, Adams ML. Perceptions and performance using computer-based testing: One institution's experience. Currents in Pharmacy Teaching and Learning. 2018 Feb 1;10(2):235-42. https://doi.org/10.1016/j.cptl.2017.10.015
13. Zahedi Z, Salehiniya H, Zarei A, Abbaszadeh H. Attitude and satisfaction towards electronic exams in medical sciences faculty members. Research and Development in Medical Education. 2021 Dec 28;10(1):29. https://doi.org/10.34172/rdme.2021.029
14. Omran E, Fathy A, Elsaiad H, Abd-elmonem A. Facilitators and barriers of employing electronic exams as perceived by nursing students and the relation to their satisfaction. Evidence-Based Nursing Research. 2022 Oct 1;4(4):33-43. https://doi.org/10.47104/ebnrojs3.v4i4.256
15. Washburn S, Herman J, Stewart R. Evaluation of performance and perceptions of electronic vs. paper multiple-choice exams. Advances in

Print ISSN: 0189-9287 Online ISSN: 2992-345X

physiology education. 2017 Dec 1;41(4):548-55. https://doi.org/10.1152/advan.00138.2016

16. Helsper, E. J., & Eynon, R. (2010). Digital natives: where is the evidence? British Educational Research Journal. 2010; 36(3): 503–520. DOI: 10.1080/01411920902989227
17. Prensky M. Digital natives, digital immigrants part 2: Do they really think differently? On the horizon. 2001 Nov 1;9(6):1-6. https://doi.org/10.1108/10748120110424816
18. Davis FD. Technology acceptance model: TAM. Al-Suqri, MN, Al-Aufi, AS: Information Seeking Behavior and Technology Adoption. 1989;205(219):5.
19. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. MIS quarterly. 2003 Sep 1:425-78.
20. Julious SA. Calculation of confidence intervals for a finite population size. Pharmaceutical Statistics. 2019 Jan;18(1):115-22.
21. Lewin, K. Field Theory in Social Science: Selected Theoretical Papers. Harper & Row. 1951
22. Van de Vliert E. Conflict and conflict management. In A handbook of work and organizational psychology. Psychology Press 2013:351-376.
23. Kim HJ, Hong AJ, Song HD. The roles of academic engagement and digital readiness in students' achievements in university e-learning environments. International Journal of Educational Technology in Higher Education. 2019 Dec;16(1):1-8.
24. Dermo J. e-Assessment and the student learning experience: A survey of student perceptions of e-assessment. British Journal of Educational Technology. 2009 Mar;40(2):203-14.
25. Yazon, A. D., Mayer-Smith, J., & Redfield, R. (2019). Integrating e-learning technologies to enhance student performance. The Turkish Online Journal of Educational Technology. 2019; 18(2): 97–106.
26. Zhang, L., & Zheng, Y. Barriers to the acceptance of online assessment in China. Education and Information Technologies. 2018; 23(6), 2225–2237.
27. Thomas, G., Singh, L., & Klopfenstein, T. (2020). A framework for student e-assessment engagement. Assessment & Evaluation in Higher Education. 2020; 45(6), 856–869.
28. Baleni, Z. G. Online formative assessment in higher education: Its pros and cons. Electronic Journal of e-Learning. 2015; 13(4), 228-236.
29. Ayo, C. K., Akinyemi, I. O., Adebiyi, A. A., & Ekong, U. O. The prospects of e-examinations implementation in Nigeria. Turkish Online Journal of Distance Education. 2019; 8(4), 125–134.
30. Buzzetto-More, N., & Alade, A. J. (2006). Best practices in e-assessment. Journal of Information Technology Education. 2006; 5, 251-269
31. Farag, A., Park, S. Y., & Faulkner, M. (2019). Device type and test performance in computer-based assessments: Evidence from higher education. Assessment & Evaluation in Higher Education, 44(1), 91–104.
32. Toth, Z., Ludányi, R., & Csapó, B. The effects of tablet-based assessment on students' attitudes. Computers in Human Behavior. 2015; 52, 735–748.
33. Ng, W. Can we teach digital natives digital literacy? Computers & Education. 2012; 59(3), 1065–1078.

Print ISSN: 0189-9287 Online ISSN: 2992-345X