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RESEARCH ARTICLE

Learning Design, Learner Engagement and Clinical Skills Acquisition of Students at Kenya Medical Training College Campuses' in Rift Valley, Kenya

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ABSTRACT

Clinical skills acquisition (CSA) is fundamental to effective patient care. However, many low-and middle-income countries, including Kenya, face persistent gaps in clinical competencies among healthcare workers. Blended learning (BL), integrating in-person and e-learning modalities, has potential to enhance learner engagement (LE) and improve CSA. Despite this, limited empirical evidence exists on how learning design (LD) and LE interact to influence CSA, particularly in sub-Saharan Africa.This study assessed the effect of learning design on CSA among students at Kenya Medical Training College (KMTC) campuses in the Rift-Valley and determined the mediating role of LE in this relationship. A cross-sectional design with a retrospective cohort component was employed. The study was conducted across nine KMTC campuses in the Rift Valley offering both nursing and clinical medicine programmes. The target population comprised 5,519 students and 9 heads of departments. A sample of 373 students was selected using stratified random sampling, alongside 9 heads of departments selected purposively. Data were collected using structured questionnaires, key informant interviews, and observation checklists. Quantitative data were analysed using multiple linear regression and mediation analysis (PROCESS Macro Model 5) in SPSS-v26 and Stata-v14, with bootstrapped confidence intervals used to assess indirect effects. Both in-person learning [b=0.26, 95% CI (0.12–0.39), p< 0.001] and e-learning [b=0.20, 95% CI (0.03–0.38), p=0.024] significantly predicted CSA. No significant interaction effect was observed, indicating additive contributions. LE partially mediated the relationship between LD and CSA [indirect effect b=0.300, 95% CI (0.163–0.472)], with a unit increase in LD indirectly influencing CSA by 9%. A dual LD combining experiential in-person training and e-learning enhances LE and improves CSA. Health training institutions should prioritise integrated instructional designs that actively foster learner engagement and develop curricula that contains well aligned in-person and e-learning modules to optimize clinical competency development.

Keywords: *Clinical skills acquisition; Learning design; Learner engagement; Blended learning; Medical education*

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INTRODUCTION

Clinical skills acquisition (CSA) is a fundamental component of healthcare education and is essential for ensuring patient safety and quality care delivery. Clinical skills remain indispensable to accurate diagnosis and patient care, however, their decline in modern training necessitates renewed emphasis on bedside teaching and robust assessment, with technology positioned as a supportive rather than substitutive tool to sustain high-quality care in the 21st century (Elder, 2018). In addition, inadequate clinical competence among nurses has been linked to knowledge gaps in medication management and limited proficiency with technology (Schroers et al., 2021). Such deficiencies in training and experience among healthcare providers compromise the overall quality of care.

Globally, particularly in low- and middle-income countries (LMICs), concerns persist regarding the preparedness of newly qualified health professionals. Evidence indicates that many graduates lack essential clinical competencies due to inadequate training and supervision (Faustinella & Jacobs, 2018). These competency gaps have significant implications for healthcare quality. Poor-quality care remains a major and often underrecognized challenge in LMICs worldwide, undermining health outcomes despite access improvements (Kruk et al., 2018). A systematic review estimated poor-quality care to account for more than 8 million deaths annually in these settings (Kruk et al., 2018). Similarly, the National Academies of Sciences, Engineering, and Medicine [NASEM] (2018) reported that poor-quality care contributes to approximately 10–15% of total deaths in LMICs. Reinforcing this concern, evidence from multiple LMICs shows persistent deficiencies in the clinical competencies of newly qualified clinicians (Lewis et al., 2019).

In sub-Saharan Africa, these gaps in the competencies of newly trained healthcare workers. remain pronounced. A training needs assessment conducted across four African countries identified substantial clinical skills gaps among mid-level health workers (Couper et al., 2018). Similarly, widespread deficiencies in clinical performance have been documented across seven African countries, including Kenya (Lewis et al., 2019). Pedagogical approaches contribute significantly to these outcomes, as teacher-centred models in medical education have been associated with reduced engagement and poorer clinical skill development compared to more interactive approaches (Grundgeiger et al., 2017). More interactive and learner-centred approaches, including gamified strategies, have been shown to improve motivation, engagement, and learning outcomes among nursing students (Andretta et al., 2025).

In Kenya, inadequate clinical competence among healthcare workers continues to pose a significant challenge. Systemic constraints within the health sector have been associated with gaps in healthcare workforce capacity and suboptimal quality of care delivery (Kimathi, 2017). Empirical studies further demonstrate that suboptimal clinical performance among nursing students is associated with limitations in clinical skills training and instructional approaches (Kweya et al., 2020). Enhanced clinical teaching approaches improve clinical judgment among nursing students (Wachira et al., 2020).

Blended learning (BL), which integrates face-to-face synchronous instruction with asynchronous e-learning, has emerged as a promising student-centred approach to address these challenges. BL environments promote flexibility, interaction, and learner-centred engagement (Attard & Holmes, 2020). The perceived usefulness and effectiveness of BL are strongly influenced by the quality of instructional design and alignment of learning activities (Kerzic et al., 2019). An effective blended learning approach empowers learners with greater autonomy and a more active role in their education, enhancing engagement and learning outcomes in large-group teaching settings (Herbert et al., 2017).

BL has consistently demonstrated improved outcomes, including greater student satisfaction, enhanced clinical judgment, better Objective Structured Clinical Examinations (OSCEs) performance and superior transfer of clinical skills compared to fully online or traditional approaches. Empirical evidence demonstrates that BL improves clinical competency across affective, cognitive, and psychomotor domains (Enoch et al., 2022). In clinical training contexts, blended approaches enhance the acquisition of clinical skills by aligning theoretical instruction with practical application (He et al., 2024). Furthermore, BL has been associated with higher levels of student satisfaction and engagement compared to traditional teaching approaches (Leidl et al., 2020). Meta-analytic evidence also indicates that it is more effective than traditional methods in medical education (Vallée et al., 2020).

The effectiveness of BL is partly explained by its ability to integrate multiple instructional modalities. Gong et al. (2021) showed that integrating online modules, virtual simulations and hands-on practice create synergistic learning experiences that promotes active learning and improves clinical performance. Similarly, integrating digital and practical learning components enhances knowledge transfer into clinical contexts and skill development (Sáiz-Manzanares et al., 2020). BL environments also support personalized and flexible learning pathways, enabling learners to progress at their own pace (Goradia, 2019). In addition, online components such as adaptive technologies and discussion forums facilitate reflective learning and enhance the overall learning experience (Shahkarami et al., 2025).

Learner engagement (LE), a multidimensional construct reflecting students' complete investment in their learning, is a critical antecedent in CSA. LE conceptualized as students' active involvement in learning processes through interaction, participation and meaningful use of instructional resources, is a key determinant of effective learning outcomes (Theelen & van Breukelen, 2022). Rameshkumar (2020) argued that LE shapes commitment, persistence, satisfaction and motivation which are key predictors of learning outcomes. Engaged learners are more likely to demonstrate self-regulated learning, active participation and deeper conceptual understanding (Regmi et al., 2024). In clinical education, increased engagement has been linked to improved preparedness for assessments such as OSCEs (Massey et al., 2017). Moreover, interactive and hybrid learning environments have been shown to enhance student participation and engagement (Battestilli et al., 2023). The use of online discussion platforms further supports engagement and deeper learning (Gasmi, 2022). Importantly, LE has been identified as a key mechanism through which BL influences learning outcomes (De Bruijn-Smolders & Prinsen, 2024). Consequently, LE may mediate the relationship between learning design (LD) in BL and CSA.

Within Kenya, the Kenya Medical Training College (KMTC) plays a central role in training middle-level healthcare workers, producing the majority (over 85%) of the country's healthcare workforce. The Rift Valley region hosts the highest concentration of KMTC campuses, making it a strategically important setting for examining educational practices and outcomes. Despite the widespread implementation of BL across KMTC campuses, there is limited empirical evidence evaluating its effectiveness in improving CSA within this context.

Although BL and LE have been widely studied, no known study in Kenya has empirically examined LE as a mediator in the relationship between LD and CSA. This represents a critical gap in health professions education research in sub-Saharan Africa. Addressing this gap is essential for informing evidence-based instructional strategies aimed at improving the quality of healthcare training and, ultimately, patient care outcomes.

The general objective of this study was to assess the relationship between LD and CSA and determine the mediating role of LE on the relationship. Specifically, the study focused on the following research objectives: (I) to assess the effect of LD on CSA of students at Kenya Medical Training College Campuses in Rift Valley, Kenya.; and (II) determine the mediating role of LE on the relationship between LD and CSA.

METHODS

Study Design

Cross-sectional and retrospective cohort designs were used. In a cross-sectional study, exposures and outcomes are measured simultaneously (Setia, 2016), enabling the collection of large volumes of data within a relatively short period and facilitating the analysis of associations between variables (Wang & Cheng, 2020). The retrospective cohort design, in which the performance of second-year students (exposed to blended learning) was compared to their first-year performance (exposed to traditional methods) on the same Patient Assessment, allowed for objective comparison of outcomes across different instructional approaches, as retrospective cohorts enable evaluation of outcomes using pre-existing data (Kim, 2023; Hendrix, P., & Griessenauer, 2019). Data for the study were collected between January and May 2025.

Study Setting

The study was conducted in nine KMTC campuses located in the Rift Valley region of Kenya. The region was chosen because its highest number of campuses relative to other regions of the country, could provide a representative sample. KMTC campuses were used in the study because they train roughly 85% of all the country's middle level health workers, offer courses that require skill competencies, and have already implemented BL (KMTC, 2019). This enabled the analysis of the effects of BL on the acquisition of clinical skills among nursing and clinical medicine students. These courses were chosen because they train critical workers that are the first to interact with patients in hospitals.

Study Population

The target population was all the 13,174 students and 62 heads of departments (HODs) in 16 KMTC campuses in the Rift Valley region (KMTC Records, 2024). However, only nine of these campuses offered clinical medicine and nursing, which were the courses of interest (KMTC Records, 2024). The accessible population was, therefore, all the 5,519 students and 9 HODs in the nine KMTC campuses. Inclusion criteria: (1) second-year students; (2) nursing and clinical medicine students; (3) HODs from the two departments; (4) willingness to participate. Exclusion criteria: (1) non-nursing or clinical medicine students; (2) unwillingness to participate.

Sampling Procedure

The study used a mix of purposive and stratified random sampling to select participants. Purposive sampling was used to select the nine HODs, enabling the study to obtain requisite information from people in charge of implementing BL. As different campuses had varied number of nursing and clinical medicine students, they were selected using stratified random sampling to minimize selection bias (Makwana et al., 2023). First, the requisite number of students from each campus was determined, followed by the department type, weighted by each stratum's target population to ensure proportionate representation. A sampling frame of the students was obtained prior to data collection, which was inflated by 20 more students in case the identified ones were absent. During sampling, students were randomly selected from the sampling frame, using Excel Random Number Generator function. Random sampling ensured that every student had an equal chance of being sampled (Creswell & Creswell, 2018).

Sample Size Determination

Sample size was calculated using Slovin's formula (Ellen, 2020), used to determine an appropriate sample size when the population is known and finite

$$n = \frac{N}{1 + N \cdot e^2}$$

n = the sample size

e = the desired level of precision/sampling error, which was +5 %.

N = 5,519

Substituting:

n=5,519/ (1+5,519 x 0.05_2)

5,519/14.7975=373

Thus, the study collected data from 373 students. For HODs, all 9 (census) were sampled. Each HOD was in charge of both nursing and clinical medicine.

Data Collection Tools

Data were collected using structured questionnaires, key informant interview (KII) schedules and observation checklist. Questionnaires and KIIs, used to collect data from students and HODs, respectively, were developed following literature review (He et al., 2024; Regmi et al., 2024; Gasmi, 2022). The questionnaire consisted of three sections: Sample characteristics; Learning design, comprising of: In-person learning (four items) and E-learning (five items); Learner engagement, consisting of three subcomponents, Level of student commitment (five items), Study habits (five items), and Ability to Adopt (six items); and Quality Clinical Skills, consisting of four domains, Decision Making Skills (five items), Knowledge Construction (five items), Knowledge Production (seven items), and Critical Thinking Skills (four items). The scale of items ranged from a minimum of unity (strongly disagree) and a maximum of 5 (strongly agree). Cronbach alpha values for In-person learning, E-learning, LE, and CS were 0.86, 0.96, 0.92, and 0.95, respectively, showing the reliability of the constructs. Principal components factor analysis using varimax rotation, extracted single components for each hypothesised construct, suggesting construct validity (Barnes & Forde, 2021). The observation checklist was used to record each student's Objective Structured Clinical Examinations scores in Years One (OSCE1) and Two (OSCE2).

Data Collection Procedure

Data were collected by the lead author as part of a larger PhD study on the effects of BL on CSA. A week before actual data collection, the researcher visited the campuses to be sampled, with an introductory letter from the University and KMTC and research permits from NACOSTI and KEMU ISERC. The researcher explained to the principal and HOD of Nursing and Clinical Medicine the purpose of the study and sought permission to conduct it. The full list of students (sampling frame) was obtained and the specific students (including the inflated ones) to be sampled from each campus and department (strata) were determined using Excel's RANDBETWEEN FUNCTION. The questionnaires in Google Form were distributed to each student via their official college email, to prevent multiple entries from a student (primary safeguard). Returned questionnaires were only accepted if they originated from a unique IP address (secondary safeguard). The questionnaires' first page included a clear explanation of the study, participant's rights, and researcher's contact details and students were required to sign the consent before proceeding. Each student was given a week to fill and return the questionnaire or was replaced by the extra students.

On specified days, determined during initial contact, the researcher conducted face-to-face interviews with HODs. This involved obtaining their consent, conducting the interview, and thanking them at the end. The researcher took notes during the interview and auto recorded the conversation for back up and clarification. The HODs also provided OSCE data.

Data Quality Control

A pilot study was done in three campuses from the neighbouring Central Region: Nyahururu, Nyandarua and Nyeri, by administering 30 questionnaires to second year nursing and clinical medicine students. Permission was obtained from the university's ISERC, NACOSTI and KMTC research Committee. Items of constructs with Cronbach Alpha values <0.7 were revised while those above with Alpha values ≥ 0.7 were adjudged to be reliable (Creswell & Creswell, 2018). During the main study, incoming questionnaires were reviewed daily to ensure fidelity in filling. Questionnaires with missing values were discarded. Similar questionnaires arising from the same student email or IP address were deleted leaving only one for use in the study.

Data Management and Analysis

Qualitative data was analysed thematically. Quantitative data were coded by assigning numeric codes to answers, allowing statistical analyses. The data were transcribed into Microsoft Excel Worksheet-version 19 and exported into statistical programs. Statistical analyses were conducted using STATA-version 14 and SPSS (Statistical Package for Social Sciences)-version 26, with significant differences in the study recorded at $p<0.05$. LD was measured using in-person learning and e-learning.

The strength of the relationships between LD, LE and CSA was assessed with Pearson's Correlation Coefficient. Correlations coefficients of < 0.35, 0.36 – 0.67 and 0.68 - 1.0, were classified as weak, moderate, or strong, respectively (Schober et al., 2018). To assess the effect of LD on CSA (Objective 1), multiple linear regression (MLR), using ordinary least squares, was used to determine both the main and interaction effects, estimated by the following equation:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X1.X2 + \varepsilon$$

Where, Y = CSA; β0 = constant; β1, β2, and β3 = coefficients to be estimated; X1 = In-person learning; X2 = e-learning; X1.X2 = interaction between in-person and e-learning; ε = error term. Interaction analysis was conducted according to guidelines outlined by Igartua and Hayes (2021). A repeated-measures ANOVA was conducted to assess the effects of LD in a BL environment on CSA by comparing OSCE1 and OSCE2.

Following Igartua and Hayes (2021) guidelines, the mediating effect of LE was modelled as the indirect effect of LD on CSA (Objective 2) and conducted using the PROCESS macro (Model 5) and structural equation modeling (SEM). Confidence intervals (CI) for the mediating effect were constructed using a bias-corrected bootstrapping method.

Ethical Considerations

Permission for study was obtained from ISERC (Approval No: KeMU/ISERC/HSM/17/2024; 08/10/2024), NACOSTI (Permit No: NACOSTI/P/24/41390; 04/11/2024), and KMTC (Ref: KMTC/ADM/74/VOL.VI (537); 03/12/2024). Permission was then sought from all participants before data collection. The nature, objective, and methods of the study were explained completely to potential respondents first. Then, consent was sought from them. No material inducement was given to potential participants. Only when informed consent was obtained did the study proceed to collect data from the respondents.

The researcher ensured that the respondents had complete freedom to ask any questions by way of clarification. The study observed strict privacy and confidentiality by ensuring that respondents did not write their identities on the questionnaire. The recorded audio from the interviews was only transcribed by the researcher.

RESULTS

Response Rate and Participant Characteristics

Out of 373 questionnaires administered to the respondents, 318 were successfully completed, producing a response rate of 85%. Response rates above 70% are generally acceptable for quantitative research and reduce the likelihood of non-response bias (Hendra & Hill, 2019). The non-response was attributed to respondents' busy academic schedules and absence during data collection. In addition, eight key informants participated in the interviews out of the nine sampled individuals (89%). One HOD was unavailable during data collection, having been deployed for an impromptu official workshop outside the study site, and could therefore not be reached within the study period.

Most students were young (17-21 years), with a progressive decrement in their number as age increased. Slightly more female students were sampled while roughly three quarters of the respondents were studying nursing (Table 1).

Table 1:

Descriptive Statistics for Student Demographic Characteristics

Variable	Response	Count	Percent
Age group	17 to 21 years	184	57.9
	22 to 26 years	113	35.5
	27 to 31 years	21	6.6
Gender	Male	155	48.7
	Female	163	51.3
Department	Clinical medicine	90	28.3
	Nursing	228	71.7

Descriptive Results

The mean for CSA was 4.01 out of maximum possible score of 5, showing that most students felt that their clinical decision-making, knowledge construction, knowledge production and critical thinking skills were good (Table 2). Overall, students perceived that both in-person mean=4.01) and e-learning (mean=3.63) strategies were effective for acquiring clinical competencies. Generally, learners perceived their engagement, study habits, and adaptability as being significant contributors to mastery of patient care procedures (mean=3.89).

Table 2:

Means, Standard Deviation, and Correlations of Variables

Variables (n = 318)	Means	SD	1	2	3	4
CSA	4.01	0.56	1			
IPL	4.01	0.75	0.53**	1		
E-learning	3.63	0.86	0.53**	0.48**	1	
LE	3.89	0.58	0.85**	0.60**	0.75**	1

*CSA=clinical skills acquisition; IPL=In person learning; LE=learner engagement; SD=standard deviation. ** = correlation significant at .01 level.*

Pearson's correlations showed significant, positive, and moderate relationships between in-person learning (r=0.53, p<0.0001), and e-learning (r=0.53, p<0.0001) [learning design] with CSA. On the other hand, LE had a significant, positive and strong correlation, r=0.85, p<0.0001, with CSA. The results showed that when in-person learning, e-learning, and LE improve, a learner's CSA also go up and vice versa. Correlations amongst the independents were significant but were <0.80, suggesting the absence of multicollinearity.

Main Effects and Interaction Analyses

The MLR model's errors were randomly scattered on the regression plot of residuals versus fitted values, indicating homoscedastic, approximately normally distributed, and non-correlated errors. Tolerance values were 0.766 and 0.743 for in-person and e-learning, respectively, showing further the tenability of the multicollinearity assumption.

Results from MLR showed that both in-person learning [b=0.26, p<0.0001, 95% CI (0.12 - 0.39)] and E-learning [b=0.20, p=<0.024, 95% CI (0.03 - 0.38)] significantly predicted CSA. The findings showed that when in-person learning increases by a unit, CSA go up by 0.26, ceteris paribus. Similarly, when e-learning increases by a unit, a learner's CSA improves by about 0.20, ceteris paribus (Table 3).

Table 3:

Results of Regression Analysis on the Effects of Learning Design on CSA

Variables (n = 318)	B	SE	β	t	p value
Main effects					
(Constant)	2.22	0.26		8.41	p < 0.0001
In-person learning (IPL)	0.26	0.06	0.34	3.66	p < 0.0001
E-learning (EL)	0.20	0.08	0.35	2.27	0.024
Interaction Term					
IPL × EL	0.003	0.02	0.03	0.13	0.896
R^2	0.379				
Adjusted R^2	0.375				
F Change	77.79				

Key: SE=standard error; IPL=In-person learning; EL=E-learning; B = Unstandardized coefficient; β = standardized beta coefficient.

Interview responses supported quantitative analysis, suggesting that students' clinical judgment was shaped by exposure to BL. For example, an informant explained that exposure to case-based blended learning strengthens diagnostic reasoning:

"… Students exposed to case-based blended learning demonstrate stronger diagnostic reasoning because they analyze before acting. Additionally, when learners practice through simulations and real clinical exposure, they become more confident in prescribing appropriate interventions …"
(KII_02, Female, 27th March 2025).

Similarly, participant number one noted that integrating online discussions with hospital practice improves independent clinical judgment:
"… Integrating online discussions with hospital practice sharpens their ability to make independent clinical judgments …"
(KII_01, Female, 25th March 2025).

Key informants believed that hands-on, face-to-face learning is central to acquiring clinical skills. One answered:

"… Clinical skills training cannot be fully replaced by online methods. Students must practice in the skills laboratory where the lecturer demonstrates and then they perform return demonstrations under supervision to ensure they are competent. However, we emphasize theory first, then demonstration and repeated practice in the lab. That is how our students gain confidence in procedures like history taking and physical examination …" (KII_03, Male, 30th March 2025).

Another respondent explained that physically performing procedures give students more confidence than relying on online materials alone:

"… Hands-on practice gives students more confidence compared to relying on online materials alone because they physically perform the procedure …" (KII_01, Female, 25th March 2025).
The interaction between in-person learning and e-learning (Figure 1) was found not to significantly predict CSA [b=0.003, p=<0.896, 95% CI (-0.04 - 0.04)].

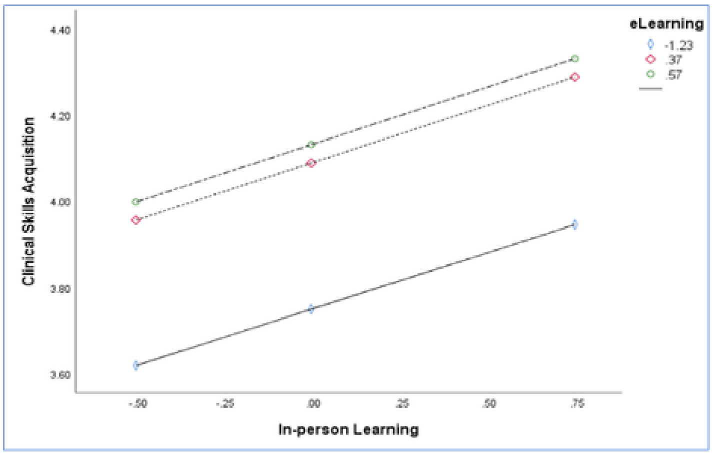

Figure 1: Interaction Graph of In-Person Learning with e-Learning on CSA

CSA is shown in figure 1 to be highest when both in-person learning and eLearning are highest (0.75 and 0.57, respectively). However, the parallel lines on the graph indicated the lack of interaction between in-person learning and eLearning. This showed that the effect of in-person learning on CSA was independent of the level of e-learning and vice versa, that is, their effects on CSA were additive.

Pre- and Post-Intervention OSCE Scores Analysis

A mixed-design (repeated-measures) ANOVA with a within-subjects factor of time of study (before and after blended learning) showed that OSCE2 scores (mean:75.91, SD: 8.74) were significantly higher than OSCE1 scores (mean: 69.33, SD: 10.42), F (1) = 182.96, p<0.0001. The test also found that the student's department [F (1) = 1.049, p=0.306], age [F (2) = 0.906, p=0.405], and gender [F (1) = 0.007, p=0.932] had no significant effect on OSCE scores. The results showed that BL significantly improved the acquisition of clinical skills among students, regardless of their department (whether nursing or clinical medicine), age or gender. Comparisons of adjusted predictions revealed that blended learning significantly increases student performance in OSCE test by 6.579 marks (roughly 9.5%) on average in second year.

Mediation Analysis

Mediation analysis results (Figure 2) showed that learning design indirectly influences a learner's CSA through its effect on learner engagement [b=0.300, 95% CI (0.163 - 0.472)]

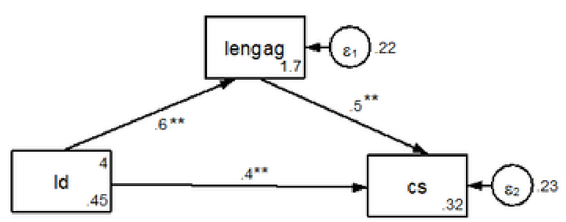

Figure 2: The mediating effect of learner engagement (lengag) on the relationship between learning design (ld) and clinical skills acquisition (cs)

*Key: **= relationship significant at .01 level; ns=not significant.*

Figure 2 shows that the path coefficients from ld to lengag [b=0.60, 95% CI (0.528 - 0.669)] and from lengag to cs, [b=0.500, 95% CI (0.398 - 0.604)] were both significantly different from zero. Thus, when LD goes up by a unit, a student's CSA improves by 0.300 (0.6 x 0.5) because of learner engagement. Since, the direct effect of LD on CSA was still significant [b=0.39, 95% CI (0.304 - 0.494)], it suggested that the mediation by LE was partial.

Qualitative findings indicated that LE was demonstrated through deliberate effort and persistence in practice, which lead to better learning outcomes.

"… Students who dedicate extra time to studying procedures on their own tend to perform better during clinical demonstrations…"
(KII_02, Female, 27th March 2025).

DISCUSSION

Findings showed significant, positive, and moderate or strong correlations between learning design (consisting of in-person learning and e-learning) and LE with CSA. Learning design significantly and positively predicted the acquisition of clinical skills. These results were reinforced by the ANOVA model, which showed that BL significantly improved student performance in OSCE test by 6.579 marks in second year. Interaction analysis revealed that the effect of in-person learning on CSA did not depend on the level of e-learning and vice versa. Hence, the total effect of LD on CSA could be estimated as a sum of in-person and e-learning effects. Learner engagement was found to partially mediate the relationship between LD and CSA, with a unit increase in LD indirectly influencing CSA.

Learning design, encompassing both in-person learning and e-learning, significantly predicted clinical skills acquisition (CSA), suggesting that improvements in instructional design are associated with enhanced clinical competency development. These findings align with prior research by He et al. (2024), Sáiz-Manzanares et al. (2020), and Gong et al. (2021) and with qualitative results from this study. Several mechanisms may underlie this relationship. First, in-person and e-learning modalities may function complementarily, with each medium reinforcing the other. Sáiz-Manzanares et al. (2020) posited that blended learning (BL) provides a continuum of learning whereby online instruction establishes foundational knowledge prior to applied clinical practice. Second, well-designed blended instruction fosters collaboration, learner-centredness, active engagement, real-world application, and formative feedback (Leidl et al., 2020; Herbert et al., 2017), facilitating knowledge and competency development consistent with Constructivist theory, which holds that learners actively construct knowledge through experiential interaction with their environment rather than through passive knowledge reception. Third, e-learning may serve as a cognitive scaffold, while in-person sessions ensure psychomotor skill mastery, which is a proposition supported by the present finding that pairing e-learning with face-to-face instruction is associated with CSA.

Interaction analysis revealed no moderating effect between in-person learning and e-learning on CSA; that is, each independently and significantly predicted CSA, indicating that the removal of either predictor would not attenuate the effect of the other. This was reasonable, since, before the emergence of digital technologies, training of health workers was entirely face-to-face, producing some good workers. On the other hand, it is possible to train health workers through online platforms (Shahkarami et al., 2025). Nevertheless, the present study found that e-learning augments in-person learning, such that CSA reflects the combined effect of both modalities — an effect greater than that of either component in isolation. This conclusion is corroborated by several studies: He et al. (2024) demonstrated that blended modules integrating online theoretical instruction with structured practical experiences improve learners' clinical performance outcomes; Sáiz-Manzanares et al. (2020) found that combining online modules, virtual simulations, and hands-on practical sessions yielded superior learning outcomes; and Gong et al. (2021) reported that a well-designed blended learning approach facilitates the transfer of theoretical knowledge to practical clinical skills. ANOVA results strongly suggested that blended learning is superior to traditional methods for clinical skills acquisition among KMTC students, indicating better skill retention and application after blended elements were introduced (He et al., 2024; Gong et al., 2021).

Learner engagement (LE) partially mediated the relationship between LD and CSA. This could be one of the first empirical reports of the mediating role of LE on the relationship between LD and CSA in Kenya. This aligns with Battestilli et al. (2023), Gasmi (2022), and Vallée et al. (2020), who found that heightened LE through online modules, simulation exercises, and practical sessions enhances clinical skills acquisition and application. Engaged learners likely complete tasks, participate in discussions, and immerse themselves in practical sessions, achieving superior learning outcomes (Regmi et al., 2024; Vallée et al., 2020). This mediating role appears especially salient in BL environments, where greater student autonomy demands higher levels of self-directed engagement. Learners with low LE may inadequately interact with online modules, undermining the deliberate practice essential for procedural mastery and patient safety (De Bruijn-Smolders & Prinsen, 2024).

Findings from this study suggests that curriculum developers at medical education institutions, such as KMTC, should implement a learning design containing well-aligned in-person and e-learning components. In-person activities should promote, experiential, practical competence, tactile precision, procedural accuracy, and clinical confidence, while e-learning activities should aim to help understand complex procedures and provide flexible, self-paced learning.

Methodological strengths of this study included an adequate sample size and high response rates of 85% and 89% among students and HODs, respectively. Potential limitations of self-reported questionnaire data were mitigated through triangulation with objective OSCE performance scores from Years 1 and 2, as well as KII. The complementary dual-design approach further enhanced rigor, with the cross-sectional and retrospective cohort designs potentially offsetting their respective weaknesses, for example, measurement variability inherent to retrospective designs (Makwana et al., 2023). The application of mixed-methods triangulation and bootstrapped mediation analysis strengthened both internal and external validity.

Key limitations included the cross-sectional design's constraints on causal inference, partially addressed through the incorporation of pre- and post-OSCE scores. Self-reported data introduced the risk of response bias, including social desirability, while student age, department, and gender potentially confounded results from the retrospective study. Accordingly, these variables were controlled for in the ANOVA model. Spatial restriction to a single region and the focus on nursing and clinical medicine students may limit the generalizability of findings. Lastly, only eight of nine HODs participated, which may slightly affect qualitative completeness.

Future studies could consider using other designs, such as an experimental study, to test further the effect of LD on CSA. Multiple regions and countries in East Africa could be used to test further the relationships established in this study.

Conclusion

This study demonstrates that both in-person and e-learning components of blended learning independently and additively enhance clinical skills acquisition, with learner engagement playing a significant partial mediating role. The results were supported by ANOVA model, which showed that BL significantly improved student performance in OSCE test by about 10% on average in Year 2. Interaction analysis revealed that the effect of in-person learning on CSA was independent of the level of e-learning and vice versa. These findings underscore the importance of intentionally designed blended learning environments that actively promote student engagement, thereby promoting the development of clinical competencies. For health training institutions such as KMTC, aligning experiential face-to-face instruction with structured e-learning components is essential for enhancing learner engagement and leading to better acquisition of clinical skills.

Recommendations

The study recommends the following:

1. Curriculum developers in health training institutions, such as KMTC, should develop curricula that combines well-aligned in-person and e-learning components, which inspire learner engagement and better clinical skills acquisition.
2. Curriculum developers in health education institutions should develop blended learning design, with activities that promote learner engagement, which energize them to seek clinical competencies.

Conflict of Interest

The authors declare no conflict of interest.

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REFERENCES

Andretta, V., Elia, R. A., Colangelo, M., Rubbi, I., Santoro, E., Boccia, G., Cascella, M., & Cerrone, V. (2025). Effectiveness of Gamification Versus Traditional Teaching Methods on Learning, Motivation, and Engagement in Undergraduate Nursing Education: A Systematic Review. International Medical Education, 5(1), 5. https://doi.org/10.3390/ime5010005

Attard, C., & Holmes, K. (2020). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. Mathematics Education Research Journal, 32, 1–22. https://doi.org/10.1007/s13394-020-00359-2

Barnes, J., & Forde, D. (2021). The encyclopaedia of research methods in criminology and criminal justice (Vol. II). John Wiley & Sons.

Battestilli, L., Bohórquez, E. B., Khan, S., & Meral, C. (2023). Exploring students' perceptions and engagement in hybrid flexible courses. In Proceedings of the Tenth ACM Conference on Learning @ Scale (pp. 110–119). https://doi.org/10.1145/3573051.3593383

Couper, I., Ray, S., Blaauw, D., Ng'wena, G., Muchiri, L., Oyungu, E., Omigbodun, A., Morhason-Bello, I., Ibingira, C., Tumwine, J., Conco, D., & Fonn, S. (2018). Curriculum and training needs of mid-level health workers in Africa: A situational review from Kenya, Nigeria, South Africa and Uganda. BMC Health Services Research, 18, 553. https://doi.org/10.1186/s12913-018-3362-9

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.

De Bruijn-Smolders, M., & Prinsen, F. R. (2024). Effective student engagement with blended learning: A systematic review. Heliyon, 10(23). https://doi.org/10.1016/j.heliyon.2024.e39439

Elder, A. (2018). Clinical skills assessment in the twenty-first century. Medical Clinics of North America, 102(3), 545–558. https://doi.org/10.1016/j.mcna.2017.12.014

Ellen, S. (2020). Slovin's formula sampling techniques. Sciencing. https://sciencing.com/slovins-formula-sampling-techniques-5475547.html

Enoch, L. C., Abraham, R. M., & Singaram, V. S. (2022). A comparative analysis of the impact of online, blended, and face-to-face learning on medical students' clinical competency. BMC Medical Education, 22, 753. https://doi.org/10.1186/s12909-022-03777-x

Faustinella, F., & Jacobs, R. J. (2018). The decline of clinical skills: A challenge for medical schools. International Journal of Medical Education, 9, 195–197. https://doi.org/10.5116/ijme.5b3f.9fb3

Gasmi, A. A. (2022). Through the lens of students: How online discussion forums affect students' learning. International Journal of Technology in Education, 5(4), 669–684. https://doi.org/10.46328/ijte.291

Gong, J., Ruan, M., Yang, W., Peng, M., Wang, Z., Ouyang, L., & Yang, G. (2021). Application of blended learning approach in clinical skills to stimulate active learning attitudes. PeerJ, 9, e11690. https://doi.org/10.7717/peerj.11690

Goradia, T. (2019). Next generation higher education: Online and blended learning. The Educational Review, USA, 3(7), 75–86. http://dx.doi.org/10.26855/er.2019.07.003

Grundgeiger, T., Hester, J., Held, V., & Hurtienne, J. (2017). Beyond knowledge acquisition: Medical device training as a cooperative process. In Proceedings of the ACM Conference on Computer Supported Cooperative Work. https://doi.org/10.1145/3022198.3026315

He, Z., Li, H., Lu, L., Wang, Q., Wu, Q., & Lu, L. (2024). Application of blended teaching in medical practical course of clinical skills training. BMC Medical Education, 24, 724. https://doi.org/10.1186/s12909-024-05730-6

Hendra, R., & Hill, A. (2019). Rethinking response rates: New evidence of little relationship between survey response rates and nonresponse bias. Evaluation Review, 43(5), 307–330. https://doi.org/10.1177/0193841X18807719

Hendrix, P., & Griessenauer, C. J. (2019). Retrospective Analysis from a Chart Review: A Step-by-Step Guide. A Guide to the Scientific Career: Virtues, Communication, Research and Academic Writing, 263-266.

Herbert, C., Velan, G., Pryor, W., & Kumar, R. (2017). A model for the use of blended learning in large group teaching sessions. *BMC Medical Education, 17*, 197. https://doi.org/10.1186/s12909-017-1057-2

Igartua, J.-J., & Hayes, A. F. (2021). Mediation, moderation, and conditional process analysis: Concepts, computations, and some common confusions. The Spanish Journal of Psychology, 24, e49. https://doi.org/10.1017/SJP.2021.46

Kerzic, D., Tomazevic, N., Aristovnik, A., & Umek, L. (2019). Exploring critical factors of perceived usefulness of blended learning. PLOS ONE, 14(11), e0223767. https://doi.org/10.1371/journal.pone.0223767

Kim, S. (2023). Overview of clinical study designs. Clinical and Experimental Emergency Medicine, 11(1), 33–42. https://doi.org/10.15441/ceem.22.410

Kimathi, L. (2017). Challenges of the devolved health sector in Kenya. Africa Development, 42(1), 55–77. http://www.jstor.org/stable/90013900

Kenya Medical Training College. (2019). Expansion policy: Training for better health. https://kmtc.ac.ke

Kenya Medical Training College Records. (2024). Current students. https://kmtc.ac.ke/resource-center/downloads

Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-DeWan, S., Adeyi, O., Barker, P., Daelmans, B., Doubova, S. V., & English, M. (2018). High-quality health systems in the Sustainable Development Goals era. The Lancet Global Health, 6(11), e1196–e1252. https://doi.org/10.1016/S2214-109X(18)30386-3

Kweya, J. O., Konyole, O. S., & Wanzala, M. (2020). Factors influencing clinical performance of diploma nursing students in Kenya. International Journal of Healthcare Sciences, 8(1), 136–142. https://www.researchpublish.com/upload/book/paperpdf-1592382023.pdf

Leidl, D., Ritchie, L., & Moslemi, N. (2020). Blended learning in undergraduate nursing education. Nurse Education Today, 86, 104318. https://doi.org/10.1016/j.nedt.2019.104318

Lewis, T., Roder-DeWan, S., Malata, A., Ndiaye, Y., & Kruk, M. E. (2019). Clinical performance among recent graduates in nine LMICs. Tropical Medicine & International Health, 24(5), 620–635. https://doi.org/10.1111/tmi.13224

Makwana, D., Priti, E., Amisha, D., & Hardik, C. (2023). Sampling methods in research: A review. International Journal of Trend in Scientific Research and Development, 7(3), 762–768. https://www.ijtsrd.com/papers/ijtsrd57470.pdf

Massey, D., Byrne, J., Higgins, N., Weeks, B., Shuker, M., Coyne, E., Mitchell, M., & Johnston, A. (2017). Enhancing OSCE preparedness with video exemplars. Nurse Education Today, 54, 56–61. https://doi.org/10.1016/j.nedt.2017.02.024

National Academies of Sciences, Engineering, and Medicine. (2018). Crossing the global quality chasm: Improving health care worldwide. National Academies Press. https://doi.org/10.17226/25152

Rameshkumar, M. (2020). Employee engagement as an antecedent of organizational commitment. The Asian Journal of Shipping and Logistics, 36, 105–112. https://doi.org/10.1016/j.ajsl.2019.11.003

Regmi, A., Mao, X., Qi, Q., Tang, W., & Yang, K. (2024). Students' perception and self-efficacy in blended learning. BMC Medical Education, 24, 1411. https://doi.org/10.1186/s12909-024-06339-5

Sáiz-Manzanares, M. C., Escolar-Llamazares, M. C., & Arnaiz González, Á. (2020). Effectiveness of blended learning in nursing education. International Journal of Environmental Research and Public Health, 17(5), 1589. https://doi.org/10.3390/ijerph17051589

Setia, M. (2016). Cross-sectional studies. *Indian Journal of Dermatology, 61*(3), 261–264. https://doi.org/10.4103/0019-5154.182410

Shahkarami, F., et al. (2025). Students' and faculty perceptions of blended internal medicine clerkship. BMC Medical Education, 25, 1221. https://doi.org/10.1186/s12909-025-07812-5

Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation coefficients: Appropriate use and interpretation. Anesthesia & Analgesia, 126(5), 1763–1768. https://doi.org/10.1213/ANE.0000000000002864

Schroers, G., Ross, J. G., & Moriarty, H. (2021). Nurses' perceived causes of medication administration errors. The Joint Commission Journal on Quality and Patient Safety, 47(1), 38–53. https://doi.org/10.1016/j.jcjq.2020.09.004

Theelen, H., & van Breukelen, D. H. (2022). The didactic and pedagogical design of e-learning. Journal of Computer Assisted Learning, 38(5), 1286–1303. https://doi.org/10.1111/jcal.12705

Vallée, A., Blacher, J., Cariou, A., & Sorbets, E. (2020). Blended learning vs traditional learning in medical education. *Journal of Medical Internet Research, 22*(8), e16504. https://doi.org/10.2196/16504

Wachira, S., Karani, A., Kimani, S., & Mageto, I. (2020). Effect of combining clinical teaching tools on clinical judgment skills. ResearchGate. https://doi.org/10.36346/sarjnhc.2020.v02i06.001

Wang, X., & Cheng, Z. (2020). Cross-sectional studies: Strengths, weaknesses, and recommendations. *Chest*, 158(1S), S65–S71. https://doi.org/10.1016/j.chest.2020.03.012